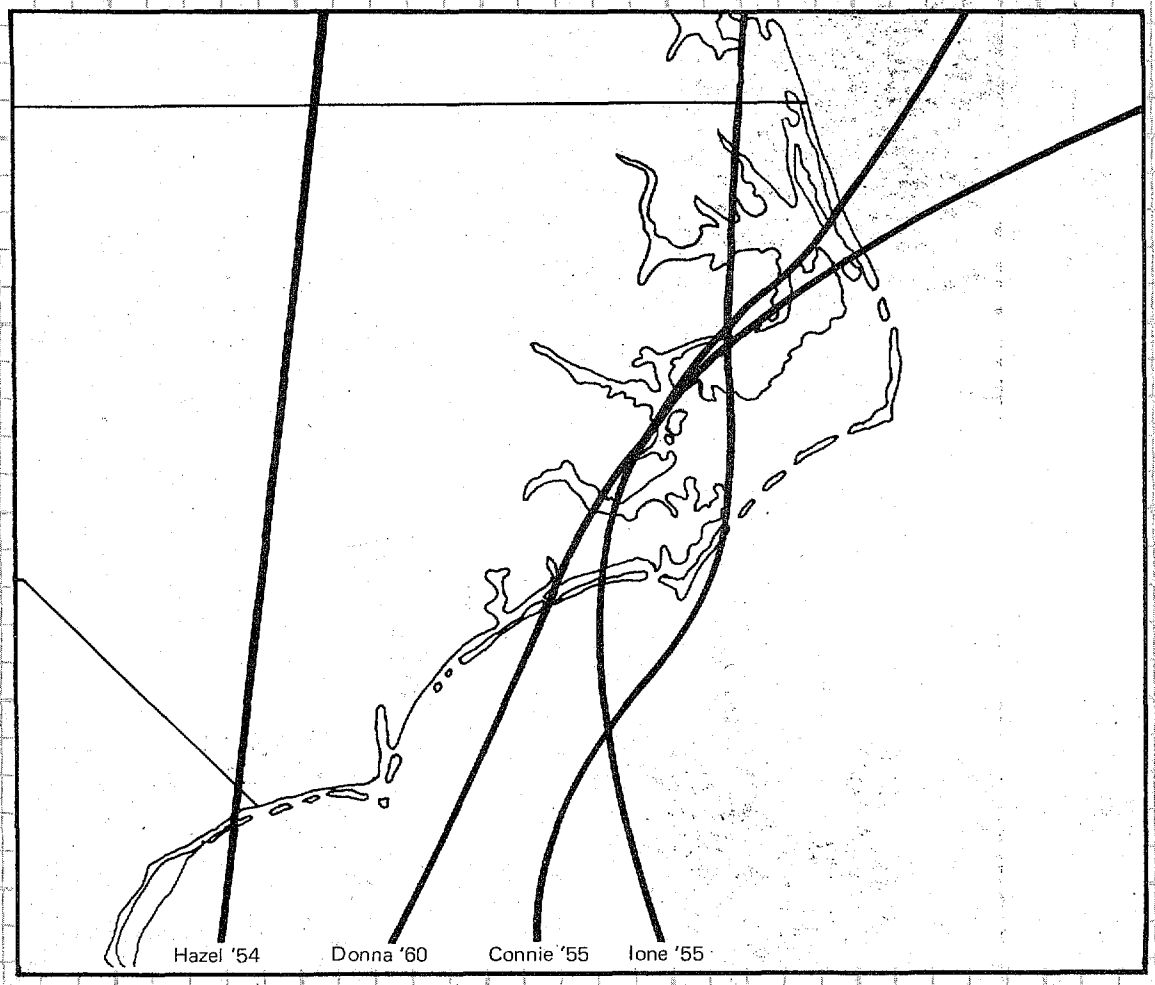
BEFORE THE STORM:

MANAGING DEVELOPMENT TO REDUCE HURRICANE DAMAGES



by

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Prepared for the
Office of Coastal Management
Department of Natural Resources and Community Development

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EXECUTIVE SUMMARY

The North Carolina coast faces a strong threat of damages from hurricanes, northeasters, and other major storms. While there has been a marked lull in the number of hurricanes that have stricken the North Carolina coast in the past 20 years, the threat still exists; many say that North Carolina is long overdue for a major storm. At the same time, development along the coast has grown by leaps and bounds. Unless this development is wisely located and built to withstand hurricane forces, North Carolina's coastal communities will face massive destruction. Local governments, as the primary protectors of the public health, safety, and general welfare, have a responsibility to reduce the risk of property damages and loss of life attending coastal development. They also have a responsibility to ensure that reconstruction following a major storm can occur quickly and leave the community safer from disaster in the future. These are the goals of hazard mitigation and reconstruction planning.

Hazard mitigation includes any activity which reduces the probability that a disaster will occur or minimizes the damage caused by a disaster. Hazard mitigation includes not only managing development, but also evacuation planning and other measures to reduce losses of life and property. Reconstruction involves the full range of repair activities in the wake of a disaster which seek to return the community to a "normal" level of operations.

The purpose of this report is to assist North Carolina's coastal communities in managing development and post-disaster reconstruction to reduce the risk of future hurricane damages. While the report deals primarily with hurricanes, it applies to other major storms as well (such as northeasters). The report identifies various tools and programs that local governments can use to manage development with an eye toward hurricane hazards. It outlines a planning process that local governments can use (1) to assess the community's vulnerability to damages given current and expected development conditions, and (2) to select appropriate actions to ensure that new development and post-disaster reconstruction are reasonably safe from future damages. It discusses procedures for assessing damages and permitting repairs and reconstruction. It identifies key programs and personnel outside the community which influence local hazard mitigation and reconstruction efforts.

The main theme underlying this report is the need to plan ahead of time for the damages that a hurricane or other major storm can cause. This planning applies to development that is taking place now in North Carolina's coastal communities; it also applies to reconstruction following a disaster. When a major hurricane or northeaster next hits North Carolina, the damage will undoubtedly be massive due to the way development along the coast has proceeded in the past. By planning now, local governments can ensure that new development and post-disaster reconstruction will not repeat old mistakes.

The Hurricane Hazard

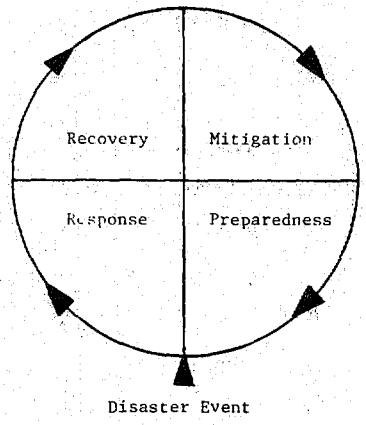
Hurricanes are extremely powerful, yet unpredictable, phenomena. The size and intensity of each hurricane is unique. While a hurricane is, by definition, a tropical weather disturbance with winds over 73 miles per hour, sustained winds in an extreme hurricane may exceed 165 miles per hour with gusts exceeding 200 miles per hour. These winds present a hazard to anything in their path. A hurricane can also cause extensive coastal and riverine flooding by creating a "storm surge" and heavy precipitation; ninety percent of all hurricane-related deaths result from drowning and the majority of property damages result from flooding. Heightened wave action and shoreline erosion accompanying a hurricane further add to the level of damages; the coastline may change shape and new inlets may form in response to the energy of a single storm. Wherever human activities stand in the path of these forces, heavy damages are likely to occur.

North Carolina history is replete with hurricanes that have changed both the physical environment and human communities. The same is true for the powerful northeasters which have hit North Carolina in the winter and early spring, causing damages similar to those of a hurricane. Based on the coast's hurricane history, the probability that the North Carolina coastline will be directly hit by a hurricane in any given year ranges from six percent near Wilmington to 11 percent around Cape Hatteras. Even though there has been a marked lull in hurricane activity in North Carolina over the past 20 years, a strong threat exists with the passing of each hurricane season.

Over the same 20 years, development along the coast has grown at a rapid pace. In addition to increases in year-round populations, coastal communities in North Carolina have experienced a surge in second-home development and tourist populations, which swell the potential for property damages and loss of life even further. This concentration of people and development in hurricane-prone communities points out the need for local officials to address the hurricane threat and reassess the policies and measures that are now in place to reduce the risk of storm damages.

Mitigating the Hurricane Hazard

Local officials need to understand the various types of activities and government functions involved in community disaster planning. Community activities regarding natural disasters fall into four related phases: mitigation, preparedness, response, and recovery. Mitigation involves activities which reduce the probability that a disaster will occur and minimize the damage caused by a disaster; they are not geared to a specific disaster, but arise from a long-term concern for avoiding damages. Preparedness activities immediately precede a particular disaster; they help the community cope with immediate threats to life and property. Response activities immediately follow a particular disaster; they include search and rescue, damage assessment, and providing emergency housing and medical care. Recovery involves the full range of repair and reconstruction activities which seek to return the community to "normal"; these activities may continue for years after a particular disaster.



Operating throughout these four phases of activity are two distinct government functions: emergency management and development management. Emergency management deals primarily with activities during the preparedness and response phases which immediately precede and follow a specific disaster; its focus is the improvement of operations in the face of disaster. Development management primarily deals with activities during the mitigation and recovery phases; its focus is the improvement of conditions in the face of disaster by providing a set of guidelines for development to follow. Unfortunately, most communities do not coordinate their emergency management activities with their development management activities. Even though they are both part of a community's comprehensive planning process, they typically operate independently of one another in working toward the common goal of reducing damages.

Hazard mitigation, or reducing the risk of damages from natural disasters, has always been a part of local planning and policy-making. In turn, many local and state governments throughout the United States have responded to natural hazards, especially flooding and high winds, by delineating hazardous areas and by instituting land use controls, construction standards, and public investment policies governing development within those areas. Nonetheless, coastal development continues at a pace that exposes ever-increasing numbers of people and properties to the forces of hurricanes; property losses due to hurricanes continue to climb.

As a result, in recent years, there has been an increasing emphasis at the state and federal levels on improving hazard mitigation policies. The National Flood Insurance Program, federal disaster assistance programs, and other federal programs are beginning to focus more on changing development conditions in disaster-prone communities. At the same time, the State of North Carolina (through the Office of Coastal Management and the Division of Emergency Management) is beginning to focus more on improving development conditions and emergency operations in hurricane-prone communities. Local government action is becoming especially more important, since local government carries the primary responsibility for managing development to protect the public health, safety, and general welfare. Given a growing concern for hazard mitigation at all levels -- federal, state, and local -- the time is ripe for local governments to plan more effectively for hazard mitigation and post-disaster reconstruction.

Hazard mitigation should be a guidepost for local decisions regarding new development and reconstruction, whether it involves private or public facilities. A number of measures are available to local governments for managing development and reconstruction to reduce the risk of storm damages. In considering these measures, local governments are likely to face the following issues: Should there be changes in land use? Should there be changes in the building code? Should we try to make the community more efficient and more attractive? What

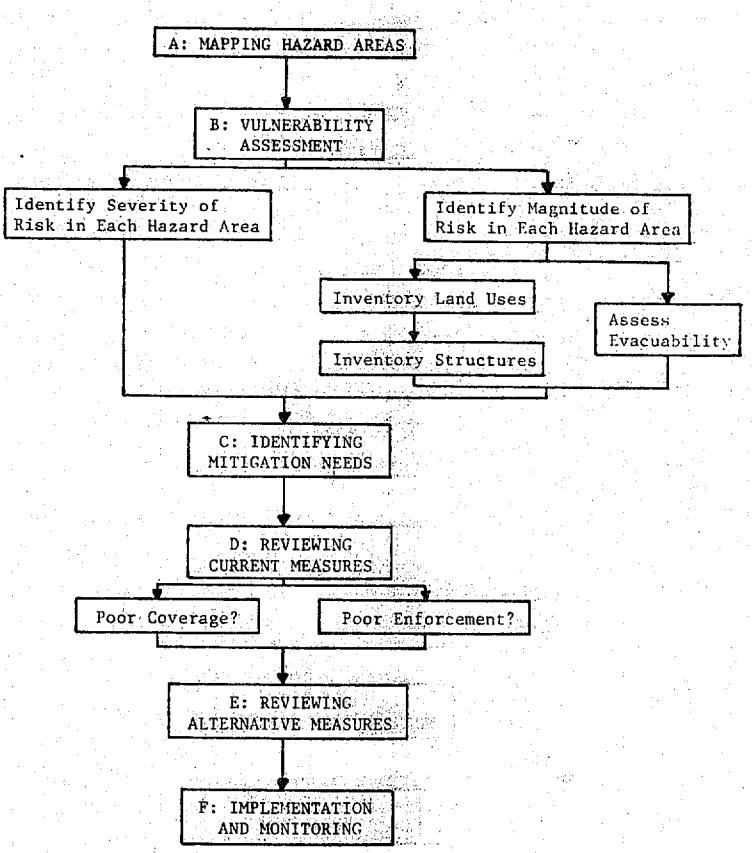
public expenditures will be involved and how will we cover them? Addressing these issues can give rise to a host of technical and political problems that local officials must overcome. The lack of community consensus regarding the level of risk that exists in the community makes these basic issues difficult to resolve. Some residents will perceive a high level of risk and press for mitigation. Others will perceive a low level of risk. Many won't think about hurricanes at all. Nonetheless, local officials need to start planning for hazard mitigation and post-disaster reconstruction now, before a major storm strikes. Too often the situation boils down to "out of sight, out of mind," where communities don't take steps to protect themselves in the long run until a massive disaster actually occurs.

Local government has available a variety of tools for managing development and reconstruction; these play a useful and essential role in coastal communities in reducing the risk of damages from flooding, erosion, and high winds. Such tools as zoning regulations, subdivision regulations, and building codes are used by communities throughout the country to protect private development from storm hazards. Public facilities siting and design criteria apply similar standards to public works decisions. Land acquisition programs can compensate landowners and keep development out of hazard areas while providing the community with more open space. All of these tools can be coordinated by comprehensive planning that accounts for storm hazards in the community and the political and technical feasibility of using different measures to manage development.

While the primary responsibility for managing development falls on local government, local government does not operate in a vacuum. State and federal programs also have a strong influence on development in hazardous areas and can set the context for local government actions regarding new development and post-disaster reconstruction. North Carolina's Coastal Area Management Program sets standards for development in statewide areas of environmental concern (which cover several hazard areas) and standards for post-disaster reconstruction. The State Building Code contains criteria for protecting buildings against high winds and other storm forces. The National Flood Insurance Program requires development to follow certain standards in order for properties in the community to qualify for federally-subsidized insurance. Federal disaster assistance programs, in providing grants and loans for the repair and reconstruction of private and public facilities, influence the pattern and quality of post-disaster reconstruction in the community. Other state and federal policies further influence the location and structural integrity of development in hazard areas. Local governments must keep all of these policies and programs in mind while formulating their own strategies for mitigating storm hazards.

Planning for Hurricane Hazard Mitigation

In planning for hazard mitigation and post-disaster reconstruction, there are several steps the community should follow to identify the community's vulnerability to storm forces, to identify and select appropriate mitigation measures, and to implement these measures and integrate them into the community's existing land use, capital improvements, and emergency operations plans. Individual communities can use this process to come up with approaches for managing new development and reconstruction that are tailored to their own unique conditions.



The first step in the process is the identification and mapping of those sections of the community which are most vulnerable to hurricane damages. Information on hazard areas can come from the National Flood Insurance Program, the CAMA program, and local experiences with severe storms. While delineating these areas, local officials should keep in mind the particular storm forces (high winds, flooding, wave action, and erosion) that are likely to appear in each area; this identifies the forces that public policy must help guard against. Once hazard areas are identified, the community can assess how vulnerable it is to damage by seeing how current and expected development patterns relate to the hazard areas. This analysis will reveal specific problems that the community needs to mitigate, setting the foundation for a review of current local development policies and alternative measures the community could adopt to handle its particular storm hazards. The final step is then to adopt and implement specific actions and to monitor their effect on new development and post-disaster reconstruction.

A case study conducted on Topsail Island, North Carolina, illustrates the hurricane hazards present in coastal communities and the ways local government can manage development to mitigate these hazards. The case study applies the planning process mentioned above to map hazard areas, assess the island's vulnerability to damages, identify mitigation needs, and review existing local development policies on the island. The case study demonstrates some of the issues facing a community which is trying to reduce the risk of hurricane

damages, both in areas that are already developed and areas that are now developing. It also points out the need for coastal communities to plan for reconstruction before the storm to minimize the chaos that attends disaster, to facilitate reconstruction, and to ensure that reconstruction leaves the community safer from the next storm.

Planning for Reconstruction

A local reconstruction plan should outline damage assessment and reconstruction permitting procedures that the community will follow after a hurricane or other major storm occurs. It should identify information that the local government will need to make sound permit decisions regarding repairs and reconstruction and to get state and federal disaster assistance. Some specific topics that the plan should address include:

1. identifying cases where repairs and reconstruction will not be permitted, or will be permitted only if they meet certain conditions;

2. guidelines (drawn from the analysis of hazards and mitigation measures) for the repair and rebuilding of damaged structures and utilities; and

3. plans for possible public acquisition of high hazard areas and the relocation of highly vulnerable and damaged structures.

By identifying and clarifying all of these policies, procedures, and information requirements, local officials will have a ready set of guidelines which will help avoid delays in reconstruction as well as make the community safer from damages in the long run.

It is crucial for local officials to understand federal and state procedures for assessing damages and applying for disaster relief aid; these procedures provide the context for local recovery activities. While they include specific things that local governments must do to receive federal and state disaster assistance, they also provide a basis for other actions, such as damage assessment, that local governments must take to implement their own hazard mitigation and reconstruction plans and policies.

As with managing development to reduce the risk of storm damages, local governments bear ultimate responsibility for emergency operations, assessing and reporting damages, requesting outside assistance, and managing reconstruction. Given the strain that this responsibility places on local resources in a time of crisis, local governments need to establish, before the storm, a ready-made set of damage assessment and reconstruction permitting procedures. These procedures should be integrated with local hazard mitigation policies that require repairs and reconstruction to include features that protect against future damages.

Putting It All Together

All of the discussion above indicates that local governments should prepare several documents in advance of a major storm to make post-disaster repairs and reconstruction move as smoothly, quickly, and efficiently as possible. These documents include: (1) a hazard mitigation plan, (2) a reconstruction plan, (3) ordinances and resolutions dealing with hazard mitigation and reconstruction, and (4) detailed and accurate property information. The hazard mitigation plan establishes the policies which new development and reconstruction will follow to reduce the risk of future storm damages. The reconstruction plan establishes procedures for assessing damages and permitting repairs and rebuilding. Ordinances and resolutions dealing with hazard mitigation and reconstruction give these policies and procedures the force of law. Maintaining detailed and accurate property information will facilitate damage assessments and reconstruction permitting decisions.

Hazard mitigation and reconstruction plans should not be prepared separately; they should operate together as part of a more comprehensive local planning effort. Comprehensive planning gives the community a forum for addressing and balancing a full range of local development objectives, not just those related to storm hazards. It allows the community to chart specific courses of action consistent with different development objectives. Local land use plans prepared in compliance with the Coastal Area Management Act, as basic comprehensive planning documents, provide a logical place for communities to identify and address hazard mitigation and reconstruction problems. By incorporating a more detailed analysis of the community's storm hazards and reconstruction permitting procedures into the local land use plan, the local government will be able to balance hazard mitigation against other development needs and objectives. The local government will be well-prepared to select an appropriate course of action that will make the community safer from hurricanes and other major storms.

While hazard mitigation and reconstruction planning should be incorporated into the community's comprehensive land use planning efforts, they should also be coordinated with the community's emergency planning efforts. Local evacuation plans, emergency operations plans, and disaster relief and assistance plans deal mainly with short-term concerns surrounding a disaster, but they also affect and are affected by the community's development decisions. Development conditions in the community will dictate what emergency actions a local government must take in the face of a major storm. Emergency plans set up the special roles local officials must play and the special procedures local government must follow during and immediately after a disaster; these can easily influence the character of post-disaster reconstruction.

This report represents an important beginning for North Carolina's coastal communities. It identifies the tools that local governments can use to manage development and post-disaster reconstruction to minimize the damages resulting from future hurricanes, northeasters, and other major storms. As the primary guardian of the public health, safety, and general welfare, local government faces an important responsibility to reduce the risk of property damages and loss of life attending coastal development. It must start planning now for the storms yet to come.

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CHAPTER 1:

INTRODUCTION

The North Carolina coast faces a strong threat of damages from hurricanes, northeasters, and other major storms. While there has been a marked lull in the number of hurricanes that have stricken the North Carolina coast in the past 20 years, the threat still exists; many say that North Carolina is long overdue for a major storm. At the same time, development along the coast has grown by leaps and bounds. Unless this development is wisely located and built to withstand hurricane forces, North Carolina's coastal communities will face massive destruction. Local governments, as the primary protectors of the public health, safety, and general welfare, have a responsibility to reduce the risk of property damages and loss of life attending coastal development. They also have a responsibility to ensure that reconstruction following a major storm can occur quickly and leave the community safer from disaster in the future. These are the goals of hazard mitigation and reconstruction planning.

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Homes in Wrightsville Beach after Hurricane Hazel in 1954

(Courtesy of N. C. Div. of Archives and History)

First is public awareness. People who live or own property in a coastal community that has not been recently hit by a major storm tend not to know about the awesome strength of hurricanes and the damages they cause. Some people ignore such information because they feel the probability of a storm striking their community is too low to merit local government action. To the extent that public awareness of a problem dictates the level of local government response to that problem, the community may find itself ill-prepared to withstand a hurricane and rebuild quickly.

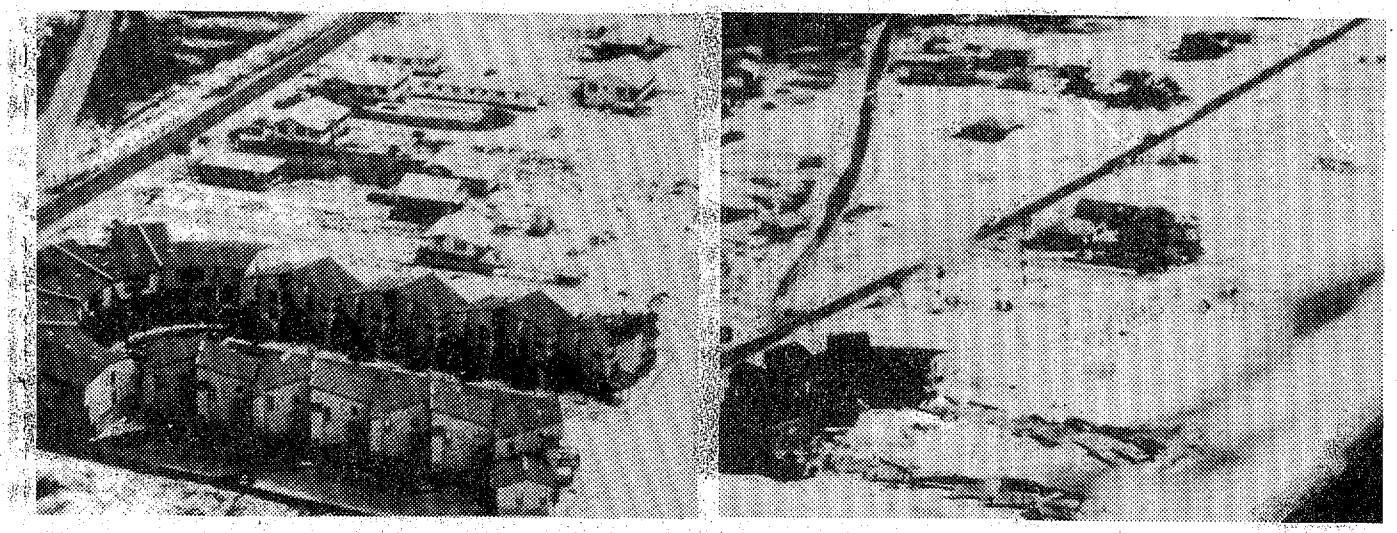
This is related to a second problem -- determining what level of protection is reasonable. Given a certain probabiliity that disaster will strike the community, its residents must choose hazard mitigation measures that they feel provide an adequate level of protection. Some people will sense a greater risk than others and, therefore, press for stronger protections against storm damages. Some people will sense a lower level of risk. The role of local government becomes that of a forum where the attitudes of different groups of people are balanced, a specific level of protection is agreed upon, and hazard mitigation measures are adopted and enforced. The measures chosen will be different for different communities, which face different levels of risk and whose residents hold different attitudes toward risk. Each community will end up with its own interpretation of what protections are reasonable.

A third problem is the lack of time after a hurricane or other disaster for making decisions regarding the character of development in the community. When disaster strikes, there is a strong drive to immediately rebuild the community as it was before, regardless of whether or not any protections are included to keep another disaster from occurring in the future. People want the community to get back to "normal" as soon as possible. This makes it difficult for local government to focus on the long-range problem of hazard mitigation and the implications that reconstruction has for the community's long-term safety. When combined with the large number of tasks that local officials and administrators must carry out right after a disaster (damage assessment, restoring utilities, debris removal, etc.), this sense of immediacy points out the need for communities to plan for disasters before they occur. If the community resolves important issues beforehand, and selects those policies and actions that it feels are reasonable and appropriate to protect against storm damages, then repairs and reconstruction can proceed quickly according to pre-determined guidelines.

Sanibel, Florida, is an excellent example of a community that is planning for hurricanes ahead of time. Since Sanibel is on the Gulf coast, its residents have long been concerned about hurricanes. In the early 1970s, while preparing its first comprehensive plan, the town found that existing rates of development were outstripping its ability to evacuate in advance of a storm. The town took steps to limit the amount of development. In 1981, Sanibel developed a hurricane evacuation and hazard mitigation plan. The plan stages evacuation according to different lengths of time before a storm's predicted arrival; this increases the number of people that can be safely evacuated. The plan also sets out specific requirements for the siting, elevation, and construction of buildings that new development and post-disaster reconstruction must follow; these requirements reduce the risk of storm damages. The plan also outlines procedures for Sanibel to follow in assessing damages and

permitting reconstruction. Even though Sanibel has not been hit by a hurricane in many years, it has recognized that a strong threat exists and has taken steps to prepare itself.

Gulf Shores, Alabama, is a community that learned its lesson the hard way. For years, development proceeded in this community with little regard for the hazards present. As Alabama's primary coastal resort, Gulf Shores built up with a full complement of single-family residences, condominiums, stores, motels, restaurants, marinas, piers, and recreational facilities. Then, in September of 1979, Gulf Shores suffered the fury of Hurricane Frederic. Buildings and roads were destroyed as the storm flooded the island, battered it with waves, and lashed it with winds of around 100 miles per hour. Eighty percent of the roughly 500 homes along the 20-mile barrier beach were destroyed (U.S. Army Corps of Engineers, 1981, p. 112). The town began rebuilding immediately after the storm, but the town board had little interest in planning the reconstruction to mitigate another disaster in the future. Buildings went back up exactly where they were before, sometimes at higher densities, even though 15-foot dunes had been washed away. The town board was swept from office at the next election. The new town board prepared and adopted a new building code and a new zoning ordinance which, among other things, require buildings to be well-braced against high winds, elevated well above expected flood heights, and located a relatively safe distance from the shoreline. However, the town was 80 percent rebuilt before the new zoning and building regulations were adopted; the new regulations will have little effect until another storm causes extensive destruction. While Gulf Shores now has a good set of development controls to reduce the risk of hurricane damages, it could have saved itself a great deal of anguish and money if the measures had been in place before Frederic hit.



Beachfront Development in Gulf Shores, Alabama, Before and After Hurricane Frederic (Courtesy of NOAA)

The main theme underlying this report is the need to plan ahead of time for the damages that a hurricane or other major storm can cause. This planning applies to development that is taking place now in North Carolina's coastal communities. It also applies to reconstruction following a disaster. With this theme in mind, the report is organized along the following lines:

Chapter 2 — The Hurricane Hazard -- briefly discussed the hurricane's destructive forces and the threat of hurricane damages in coastal North Carolina;

Chapter 3 — Mitigating the Hurricane Hazard -- discusses the emergency management and development management functions of local government, the hazard mitigation concept, and the issues surrounding mitigation and post-disaster reconstruction;

Chapter 4 — Tools and Programs for Hurricane Hazard Mitigation -- presents current state and federal programs influencing development and reconstruction in hurricane-prone communities, and presents measures that local governments can use for managing development to reduce the risk of storm damages;

Chapter 5 — Planning for Hurricane Hazard Mitigation -- presents steps that a local government can take to assess its vulnerability to storm damages and to select and implement appropriate development and reconstruction policies;

Chapter 6 — Topsail Island Case Study -- applies several of these steps to the three communities on Topsail Island to illustrate different hazard-related development problems and different local policies that address them;

Chapter 7 — Planning for Reconstruction -- presents federal and state procedures for assessing damages and applying for disaster relief aid, discusses the local role in emergency response and recovery, and outlines steps for local governments to take in establishing their own damage assessment and reconstruction permitting procedures.

The information in this report will help local governments in coastal North Carolina plan better to minimize hurricane damages and to facilitate post-hurricane reconstruction. It will also help them plan in advance of actual damages and be well-prepared for when a storm strikes. When a major hurricane next hits North Carolina, the damage will undoubtedly be massive due to the way development along the coast has proceeded in the past. By planning now, local governments can ensure that new development and reconstruction will not repeat old mistakes.

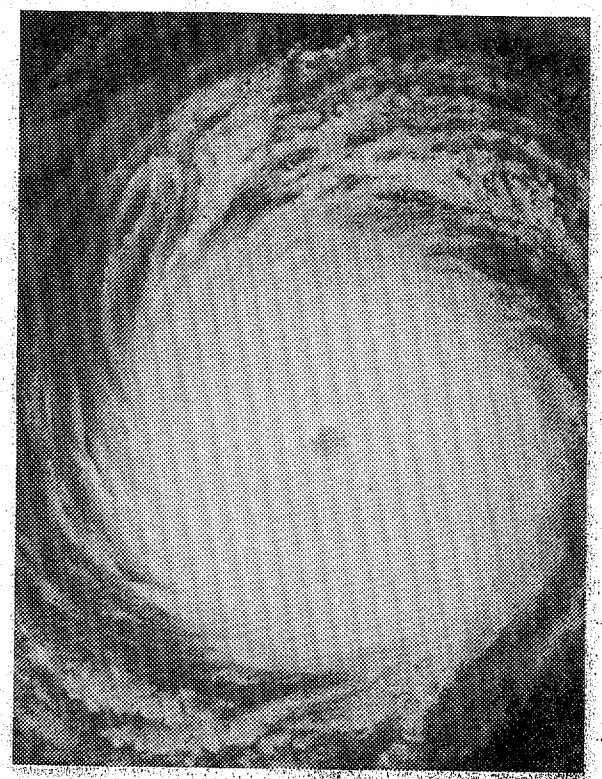
REFERENCES: CHAPTER 1

U.S. Army Corps of Engineers--Mobile District. 1981. Hurricane Frederic Post-disaster Report. Mobile, AL: U.S. Army Corps of Engineers.

CHAPTER 2:

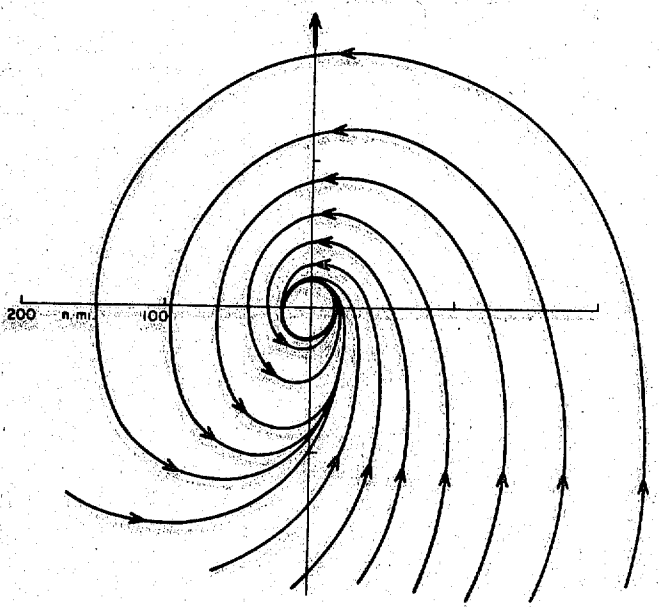
THE HURRICANE HAZARD

A hurricane resembles a large, shallow funnel. Air flows in a counter-clockwise direction from high pressure areas along the storm's periphery to a concentrated center of extremely low pressure (see Figure 2.1). While a hurricane system may have a radius of 1,000 kilometers, hurricane-force winds are usually confined within 100 kilometers of the storm's center (Simpson and Riehl, 1981, p. 8). The storm's center consists of a cylindrical wall of clouds, where winds are their strongest and may reach speeds of 200 miles per hour. Surrounded by this wall of clouds is the hurricane's "eye," an area of relative calm several miles in diameter which has little wind or rain.



Satellite View of Hurricane Frederic (Courtesy of NOAA)

Figure 2.1: Typical Pattern of Hurricane Winds



Source: Simpson and Riehl, 1981, p. 126.

Atlantic hurricanes begin as low-intensity storm systems and form predominantly in the Caribbean Sea and the western Atlantic Ocean, although some storms which affect the United States coast originate off the west coast of Africa. Following initial formation, storm systems pass through increasingly intense phases, classified as tropical depressions (winds less than 40 miles per hour), tropical storms (winds between 40 and 73 miles per hour), and hurricanes (winds 74 miles per hour or greater). While the hurricane season runs from June through November, hurricanes tend to be more frequent in late summer and early fall. Along the North Carolina coast, over ninety percent of all recorded hurricanes have occurred in August, September, and October. Ocean

temperatures, and air temperature and humidity near the ocean surface, are greatest at this time, providing a large source of energy to drive the hurricane storm system.

Hurricanes are typically classified according to the Saffir/Simpson Damage Potential Scale (see Table 2.1), which categorizes hurricanes according to their wind speeds, storm surge levels, and atmospheric pressure. This scale is used by the National Weather Service to give public officials an estimate of a hurricane's potential for wind and storm surge damage as it approaches the U.S. coastline. A hurricane is designated on a scale of 1 to 5 based on observations made while the storm is in progress, with a 1 indicating the weakest storm. The designation changes as new observations are made during the storm's lifespan as the storm gains or loses strength.

Hurricanes tend to follow a parabolic path, moving westward across the Atlantic and Caribbean and curving north or northeast as they move out of the tropics and into the westerly air currents of higher latitutdes. The forward movement of the hurricane system is relatively slow, usually around 15 miles per hour, but exceptions are not unknown. For example, Hurricane Hazel had a forward speed of between 25 and 35 miles per hour. As hurricanes move out of the tropics, their movement increasingly depends on air flow patterns in the higher latitudes, which are generally unsteady and unpredictable. A hurricane moving on a "normal" parabolic path may stop dead in its track, reverse direction, or take a sharp turn, all in response to changes in atmospheric currents. Figure 2.2 shows the erratic path of Hurricane Ginger in 1971, from formation south of Bermuda on September 6 to landfall and exit in North Carolina on October 1 and 2.

Residents of areas susceptible to hurricanes rely on the National Hurricane Center in Miami, Florida, for predicting the paths and intensities of advancing storms. The Center employs reconnaissance aircraft, weather satellites, radar, observations from ships at sea, and ocean buoy systems to monitor hurricane movements. It employs sophisticated models to predict the paths hurricanes will take. However, major forecasting problems still exist.

The average error in predicting a hurricane's path is about 80 kilometers 12 hours before the storm's arrival (Simpson and Riehl, 1981, p. 300). Even

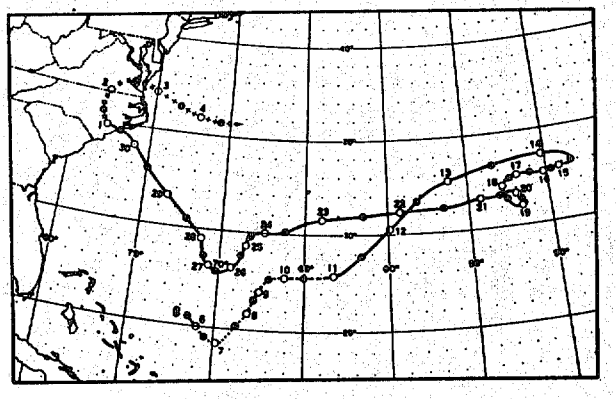


Figure 2.2: Track of Hurricane Ginger, 1971.

Source: Neumann et al., 1981, p. 133.

Table 2.1: Saffir/Simpson Damage Potential Scale

Scale No. 1—Winds of 74 to 95 miles per hour. Damage primarily to shrubbery, trees, foilage, and unanchored mobile homes. No real damage to other structures. Some damage to poorly constructed signs. And/or: storm surge 4 to 5 feet above normal. Low-lying coastal roads inundated, minor pier damage, some small craft in exposed anchorage torn from moorings.

Scale No. 2—Winds of 96 to 110 miles per hour. Considerable damage to shrubbery and tree foliage; some trees blown down. Major damage to exposed mobile homes. Extensive damage to poorly constructed signs. Some damage to roofing materials of buildings; some window and door damage. No major damage to buildings. And/or: storm surge 6 to 8 feet above normal. Coastal roads and low-lying escape routes inland cut by rising water 2 to 4 hours before arrival of hurricane center. Considerable damage to piers. Marinas flooded. Small craft in unprotected anchorages torn from moorings. Evacuation of some shoreline residences and low-lying island areas required.

Scale No. 3—Winds of 111 to 130 miles per hour. Foliage torn from trees; large trees blown down. Practically all poorly constructed signs blown down. Some damage to roofing materials of buildings; some window and door damage. Some structural damage to small buildings. Mobile homes destroyed. And/or: storm surge 9 to 12 feet above normal. Serious flooding at coast and many smaller structures near coast destroyed; larger structures near coast damaged by battering waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Flat terrain 5 feet or less above sea level flooded inland 8 miles or more. Evacuation of low-lying residences within several blocks of shoreline possibly required.

Scale No. 4—Winds of 131 to 155 miles per hour. Shrubs and trees blown down; all signs down. Extensive damage to roofing materials, windows and doors. Complete failure of roofs on many small residences. Complete destruction of mobile homes. And/or: storm surge 13 to 18 feet above normal. Flat terrain 10 feet or less above sea level flooded inland as far as 6 miles. Major damage to lower floors of structures near shore due to flooding and battering by waves and floating debris. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Major erosion of beaches. Massive evacuation of all residences within 500 yards of shore possibly required, and of single-story residences on low ground within 2 miles of shore.

Scale No. 5—Winds greater than 155 miles per hour. Shrubs and trees blown down; considerable damage to roofs of buildings; all signs down. Very severe and extensive damage to windows and doors. Complete failure of roofs on many residences and industrial buildings. Extensive shattering of glass in windows and doors. Some complete building failures. Small buildings overturned or blown away. Complete destruction of mobile homes. And/or: storm surge greater than 18 feet above normal. Major damage to lower floors of all structures less than 15 feet above sea level within 500 yards of shore. Low-lying escape routes inland cut by rising water 3 to 5 hours before hurricane center arrives. Massive evacuation of residential areas on low ground within 5 to 10 miles of shore possibly required.

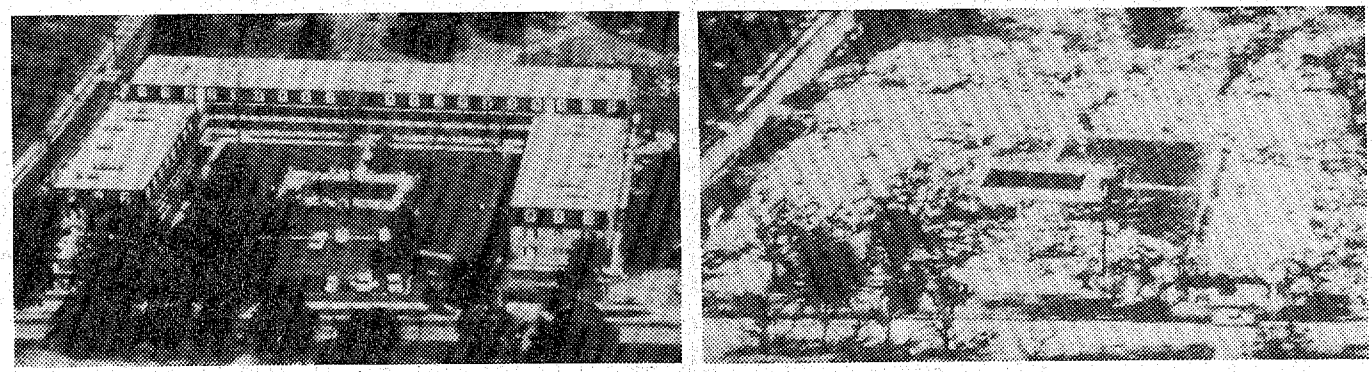
Source: Neumann et al., 1981, p. 25.

when following the predicted path, a hurricane may vacillate around it, causing differences in the place of landfall by 100 kilometers or more. Since most of the hurricane's destructive power is centered in a 100-kilometer radius, the difficulties in landfall prediction appear formidable. There are cases in which a hurricane has directly approached a coastline, halted, and then sharply turned away. In contrast, there other situations in which the storm moved directly inland when it was predicted to skirt the coast.

IMPACTS AND COMPONENTS OF A HURRICANE

The two most drastic effects of hurricanes are fatalities and property damage. Since the turn of the century, the general trend has been toward a reduction in the number of deaths from hurricanes but an exponential increase in the amount of property damage. Figure 2.3 illustrates these trends to 1970.

The main reason for the reduction and stabilization in death rate has been a combination of improvements in monitoring and warning systems and local preparedness and evacuation planning. However, as the population continues to grow in coastal areas beyond the point of safe evacuation within the available warning time, the potential for substantial loss of human life remains.



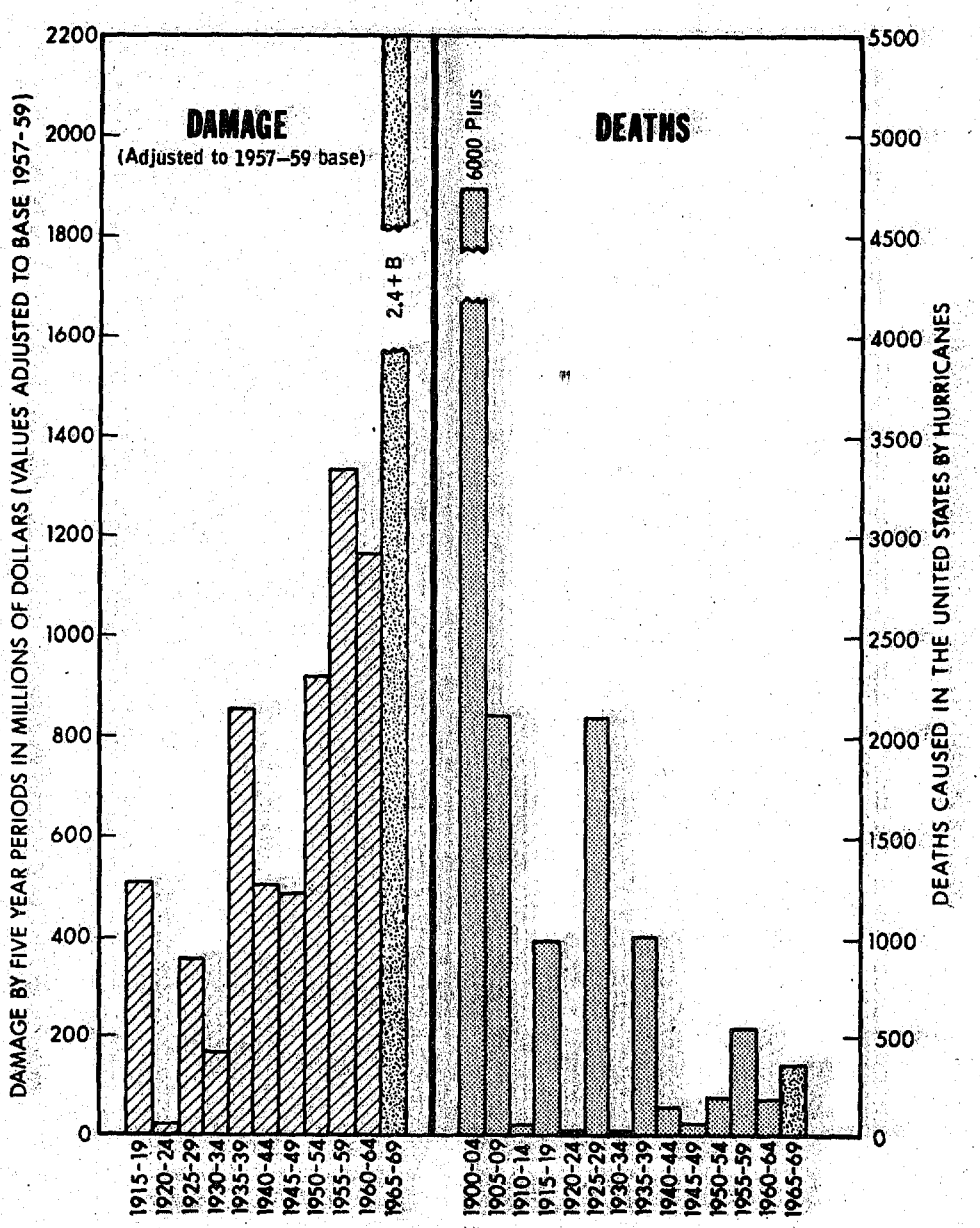
The Richelieu Apartments on Mississippi's Gulf Coast Before and After Hurricane Camille in 1969. Over 20 people died here while having a "Hurricane Party." (Courtesy of NOAA)

While hurricane fatalities have decreased since 1900, the increase in property damages is staggering. This increase in damages parallels the increase in population and development in coastal hurricane-prone areas since World War Two. Property damages stem mainly from riverine flooding, storm surge flooding, and the waves which ride on top of the surge. They also stem from erosion beneath structures built too near the water, and from high winds, which can affect a very large area.

High Winds

A hurricane is identified primarily in terms of its high winds and low atmospheric pressure; by definition, a hurricane is a tropical weather disturbance with winds exceeding 73 miles per hour. Where a hurricane is moving directly shoreward at 14 to 17 miles per hour, winds can be expected to reach hurricane force at the open shoreline three to six hours before the eye makes landfall (Simpson and Riehl, 1981, p. 212). In a hurricane of moderate

Figure 2.3: Deaths and Damages from Hurricanes in the United States



Source: Office of Coastal Zone Management, 1976, p. II-12.

strength, winds will increase as the hurricane center approaches, reaching maximum sustained speeds of about 100 miles per hour at sea level with peak gusts of over 130 miles per hour as the center moves onshore. In an extreme hurricane, sustained winds may exceed 165 miles per hour at the coast, with peak gusts exceeding 200 miles per hour. A hurricane's strongest winds appear in the leading right-hand quadrant of the storm system (see Figure 2.4).

As the storm moves inland, friction from the land surface will generally dissipate the high winds. However, a narrowing zone of major wind damage, 30 to 35 percent of that at the shoreline, can extend much further inland (Simpson and Riehl, 1981, p. 214). Little or no change in wind speed occurs above 100 meters elevation either at the shore or inland. In fact, winds at 100 meters elevation are generally 30 to 50 percent stronger than those recorded at sea level (Simpson, 1981, p. 213).

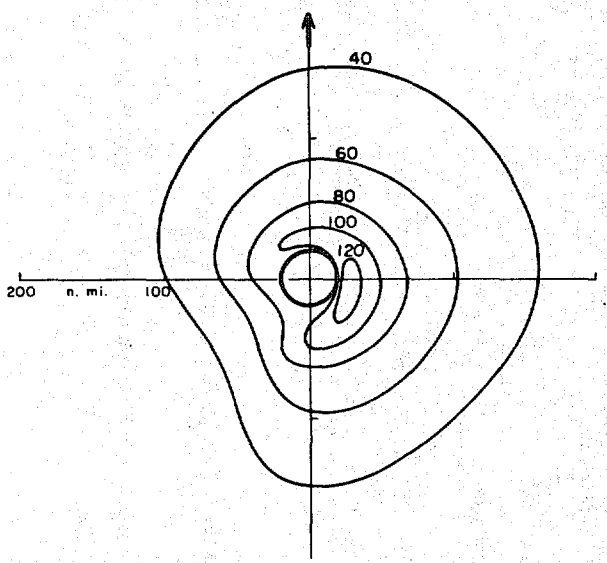


Figure 2.4: Model of Wind Speed Distribution for a Moderate Hurricane

Source: Simpson and Riehl, 1981, p. 128.

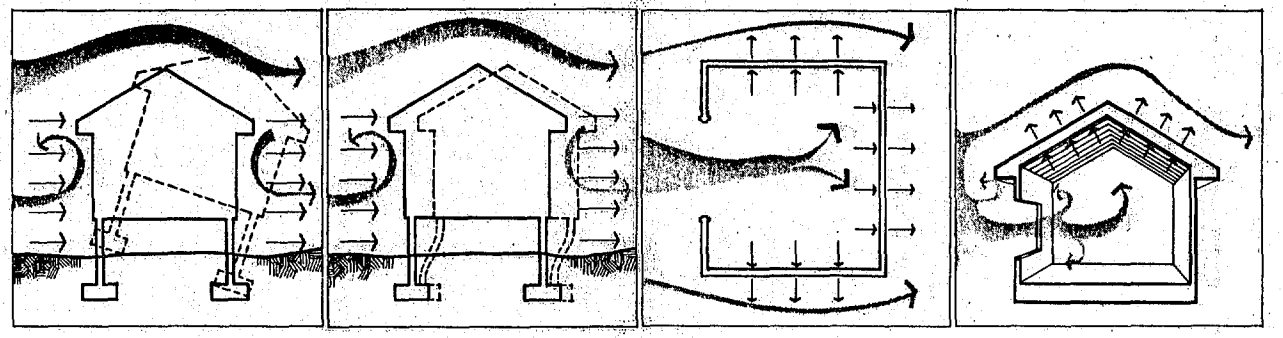
In addition to the regular wind pattern around the eye, tornadoes may sometimes accompany a hurricane. This is not a well-understood phenomenon nor does it occur in all hurricanes. These tornadoes behave much as the more common Midwestern variety and can cause considerable damage. Hurricane Agnes, for example, spawned some 15 tornadoes in Florida, resulting in total property losses of 4.5 million dollars (Baker, 1978, p. 25).

High winds place severe stresses on buildings (see Figure 2.5) and cause a major portion of hurricane-related property damages. High winds can tear the roofs and walls off of buildings. They can overturn mobile homes. They can fell trees, crops, and powerlines. They can also carry debris and slam it against walls, doors, and windows.

Flooding

The hurricane's storm surge and its excessive precipitation cause massive coastal and riverine flooding. About 90 percent of hurricane deaths result from drowning; the majority of property damages result from flooding.

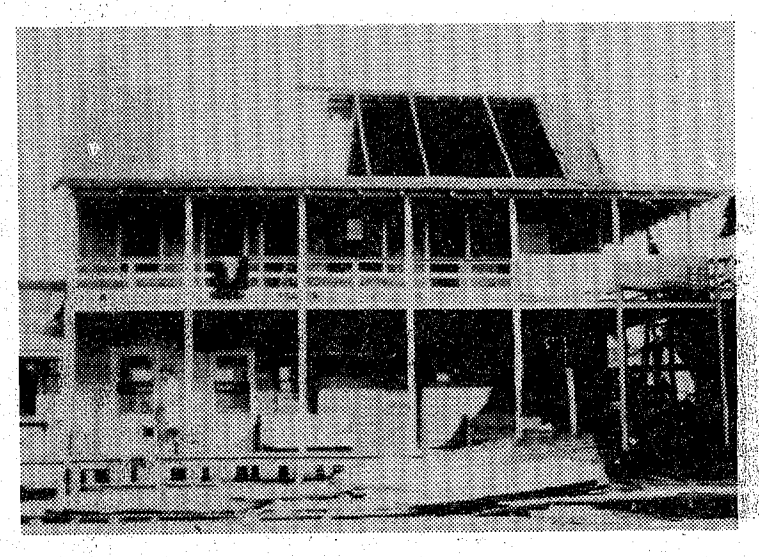
Figure 2.5: Wind Forces on Buildings



Overturning Displacement Pressure on Walls Roof Uplift

Source: Dames and Moore, Inc., 1981, pp. 44-45.

The hurricane system, with its high winds and low pressure moving across the open ocean, pushes up an enormous swell of water before it. This mass of water, called the storm surge, can cause extreme elevations in mean sea level and leads to coastal flooding. The height of the surge along the open coast depends on a number of factors which include wind speed, normal water depth, storm trajectory, and forward speed of the storm. A hurricane storm surge coinciding with the natural high tide can cause even greater damage. As with the hurricane's winds, the surge is highest in the leading right quadrant of the storm system.

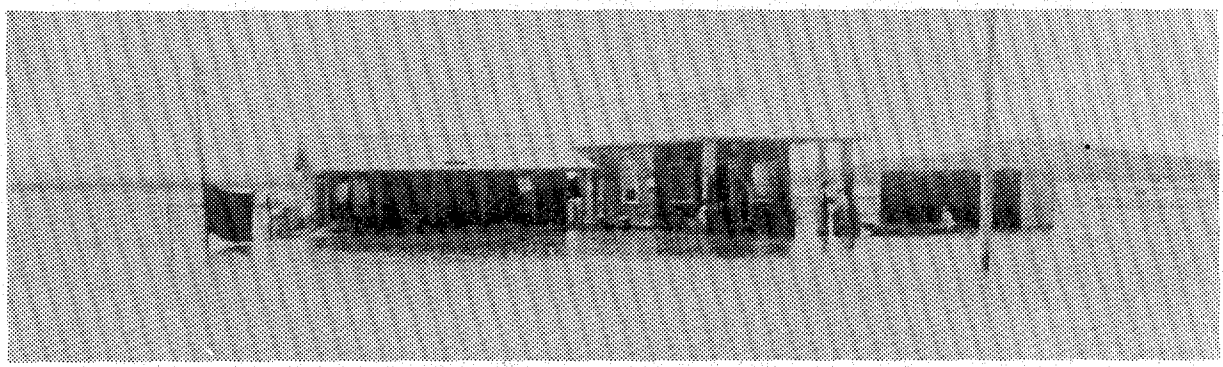


The roof of this house in Nags Head was torn off by a storm in 1933.

(Courtesy of N. C. Div. of Archives and History)

The surge does not strike the coast as a wall of water like the tsunami, but instead as a rapid elevation in sea level. In 1954, Hurricane Hazel brought a 14.7-foot increase in mean sea level at Holden Beach, an 11.7-foot increase at Southport, and an 8.8-foot increase at Carolina Beach (N.C. Council on Civil Defense, 1955, pp. 18-19). In bays and estuaries, the elevation of sea level due to the storm surge may exceed that at the open coast by a factor of 50 percent or more (Simpson and Riehl, 1981, p. 242). This is primarily due to high winds funneling water into narrow and shallow bays and estuaries.

The flooding of coastal areas with seawater not only causes extensive damage to buildings and their contents but also may render agricultural lands useless for most crops by contaminating soils with salt water. During the North Carolina hurricanes of 1954 and 1955 (Hazel, Connie, Diane, and Ione), most of the land less than 10 feet above sea level suffered from salt water intrusion and extensive crop damages. About 25 percent of the area of 22 eastern counties was estimated to have been covered by fresh and salt water during these hurricanes (N.C. Council on Civil Defense, 1955, p. 28). In addition, flotsam, including boats or other structures lifted by the hurricane surge and pushed by winds, may be transported inland and become battering rams, causing additional damage.



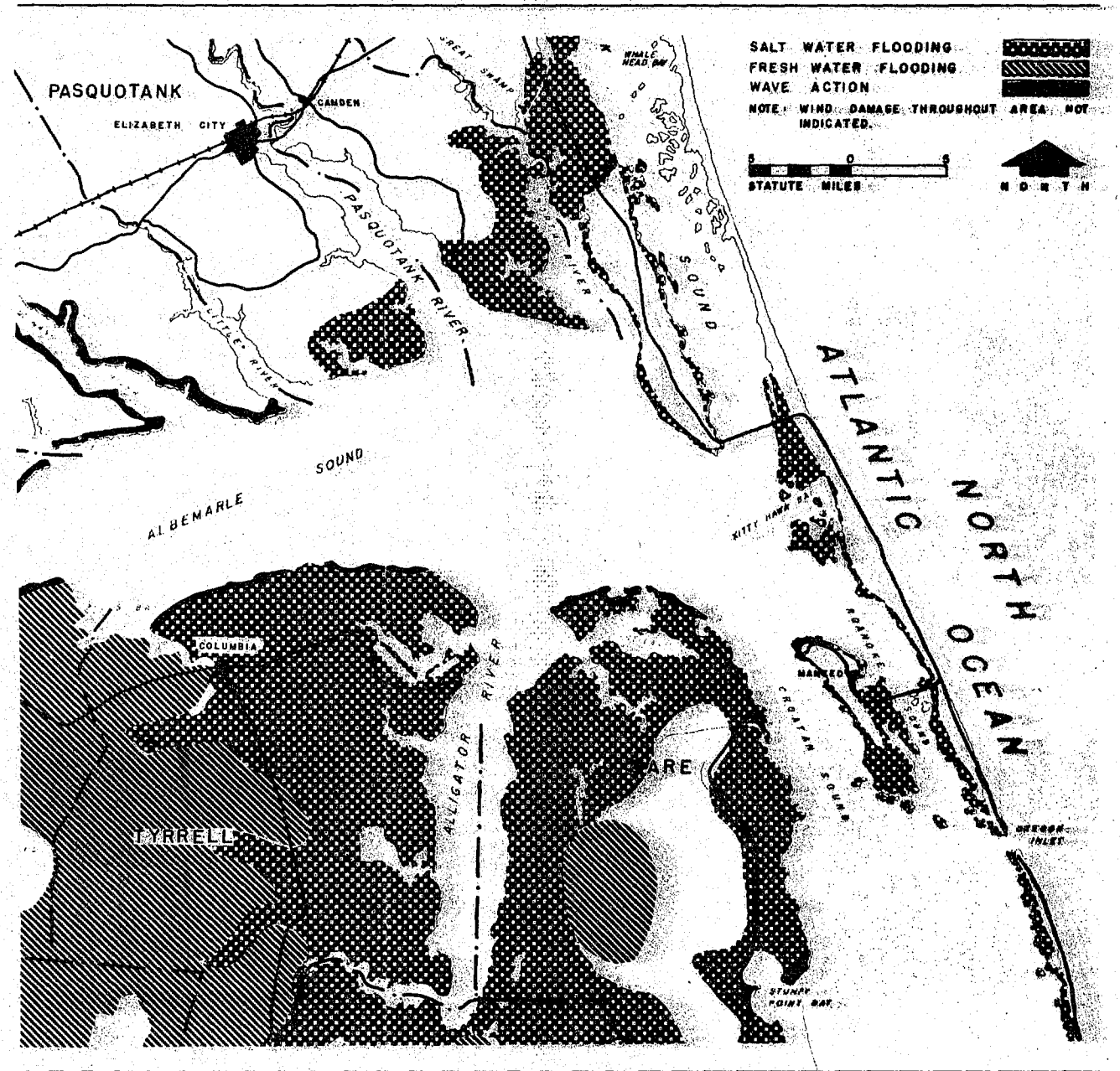
Flooding on the Dare Beaches from a storm in 1933.
(Courtesy of N. C. Div. of Archives and History)

The contribution of the hurricane's excessive rainfall to coastal flooding is difficult to separate from the storm surge. However, in inland streams, this rainfall can cause significant flooding. Rainwater can flood areas that the storm surge cannot reach. This freshwater flooding may be as destructive as the storm surge. Figure 2.6 shows the extent of freshwater flooding and salt water flooding in Albemarle Sound due to the hurricanes of 1954 and 1955.

Widely differing levels of precipitation have been reported for different hurricanes, ranging from practically nothing (in spite of hurricane-force winds) to over 40 inches for any one place along the storm's path. Hurricane Frederic, which struck the Louisiana, Alabama, Mississippi, and Florida coasts in September of 1979, showed a typical rainfall pattern. The National Weather Service station at Mobile, Alabama, recorded 8.6 inches of rain before its gauge was blown away. An 11-inch gauge overflowed at the home of the Civil Defense Direction in Pascagoula, Mississippi. The highest official reported rainfall for a 24-hour period during Frederic was 9 inches (U.S. Army Corps of Engineers, 1981, p. 59).

A hurricane may continue to deposit heavy rainfall far inland. Hurricane Frederic, upon making landfall on the Gulf coast, continued to move north with declining wind speeds but continuing heavy precipitation. Akron, Ohio, recorded over 8 inches of rain due to Frederic (U.S. Army Corps of Engineers, 1981, p. 60). Hurricane Agnes did damage in excess of two billion dollars in the Northeast in 1972; the vast majority of this damage came from heavy precipitation and riverine flooding in Pennsylvania, New York, and adjacent states.

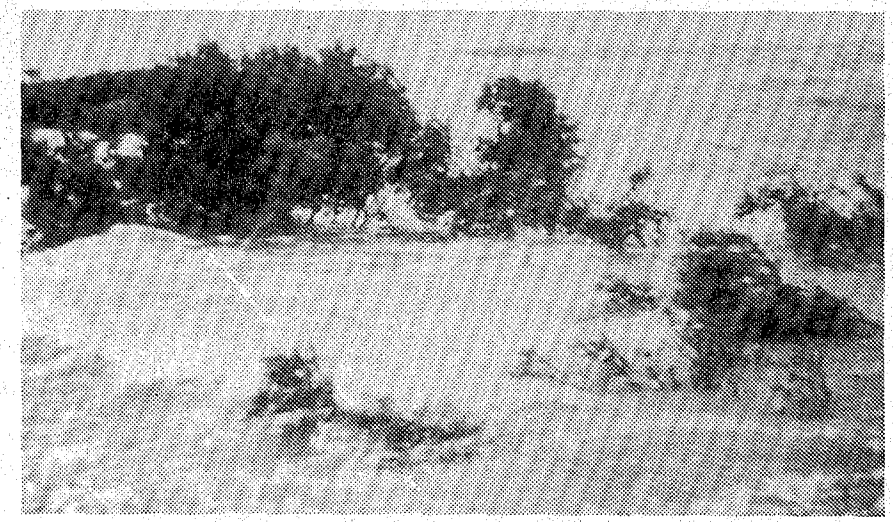
Figure 2.6: Flooding in the Albemarle Sound Region from Hurricanes Hazel, Connie, Diane, and Ione (1954-1955)



Source: N. C. Council of Civil Defense, 1955.

Wave Action

An important component of the storm surge is the wind-driven waves which ride on top of the surge and can cause extensive damage. The size of the waves is tied to the direction and speed of the wind, the water depth, and the normal direction of wave movements. The height of these waves also depends partly on the slope of the ocean bottom near the shore. A gently sloping coast will see minimal wave action; areas where the ocean bottom falls off rapidly will experience higher waves. High storm waves appear not only on the ocean, but also on broad sounds where there is enough water depth and fetch for high winds to push up a wave. The height of storm waves is generally about 50 percent of the depth of the storm surge; therefore, a ten-foot storm surge may be accompanied by five-foot waves.



Storm Surge Flooding and Wave Action Batter the Coast

(Courtesy of NOAA)

Waves on top of a storm surge can have several important effects. First, the waves can reach and flood areas not reached by the surge itself. Second, waves act as direct battering forces. The force of a wave against a structure is a function of the size of the wave and the speed at which it is moving. Finally, waves may be responsible for massive erosion along beaches, dunes, and wherever they reach. Inland from an open coast or a bay shore, waves become diffracted and their energies dispersed by buildings, dunes, or forested areas; consequently, wave damages diminish.

Erosion

Extreme winds, high waters, and heavy wave action may accelerate or change normal patterns of wave movement and sand transport to cause drastic shoreline changes, especially on a barrier island. The coastline may change shape, and new inlets may form in response to the energy of a single storm. Vast amounts of sand may be removed by wave scour from beaches and dunes and carried away by strong longshore currents. The geological history of North Carolina's coastline attests to the power of hurricanes and other storms and their ability to erode beaches and open and close inlets. Inlets tend to form or widen after a storm surge builds up within a sound and gravity pushes the water back out to sea. In 1967, Hurricane Beulah cut 31 inlets through Padre Island, Texas; most of these breaches gradually filled back in (Simpson and

Riehl, 1981, p.244). In addition to severe erosion along the ocean shoreline, severe erosion can also occur along estuarine shorelines as waves travel across broad sounds and batter beaches and bluffs.

HURRICANES AND NORTH CAROLINA

Each summer brings to the North Carolina coast the potential for hurricane damages. Coastal North Carolinians' experiences with hurricanes date back to the earliest settlers. Since 1899, North Carolina has received direct hits from 21 hurricanes, eight of them classified as "major" (a 3, 4, or 5) on the Saffir/Simpson Scale (Neumann et al., 1981, p. 28). These are cases where the center of the storm passed directly over the North Carolina coast. The state has also suffered damages from numerous hurricanes whose centers came through South Carolina or stayed at sea, passing close to the North Carolina coast. Appendix A lists the storms of hurricane strength that have affected North Carolina in the twentieth century. The probability that a section of the North Carolina coastline will be directly hit by a hurricane in any given year ranges from six percent near Wilmington to 11 percent around Cape Hatteras (see Figure 2.7).

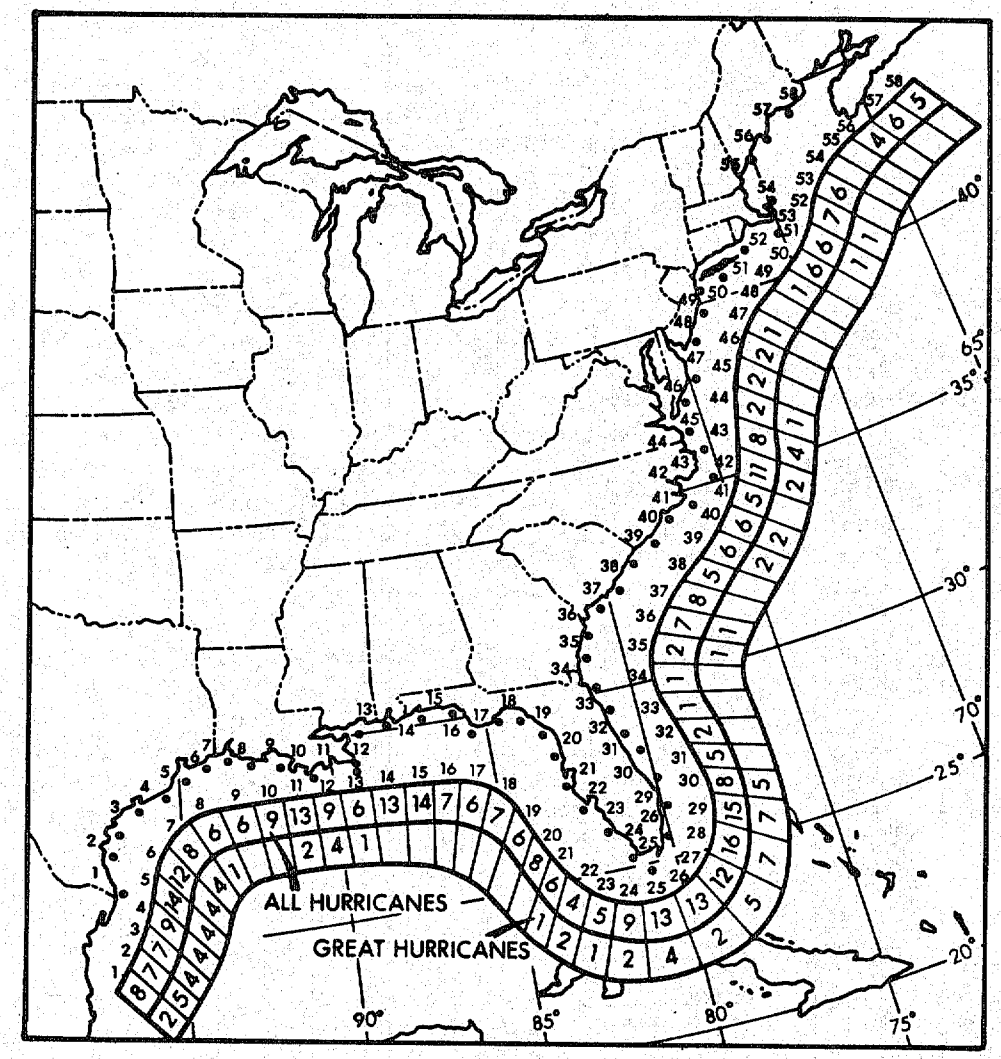
North Carolina has not experienced major damage from a hurricane in over ten years, when Hurricane Ginger made landfall near Morehead City. While no one was killed, damage was estimated at ten million dollars and include thousands of acres of corn and soybeans in the eastern counties (Baker, 1978, p. 73). In 1979, Hurricane David made landfall in South Carolina and moved inland. Most of the storm activity was centered over the Piedmont, but coastal North Carolina did not escape entirely. Massive erosion was triggered from Sunset Beach to Topsail Beach; thirty to forty feet of beach were lost at Holden Beach and Yaupon Beach. Several fishing piers were damaged, but overall property loss was low, and no deaths occurred.

This is slight in comparison to the hurricanes which devastated North Carolina in the mid-1950s. Between August 1953 and September 1955, seven hurricanes, four of them (Hazel, Connie, Diane, and Ione) classified as major storms, rocked the Carolina coast. Damage from these storms was estimated to be in excess of 300 million dollars (1955 dollars) (N.C. Council on Civil Defense, 1955, pp. 21-23). The increase in development since this time leaves coastal North Carolina vulnerable for even greater damage today.

Hurricane Hazel

An account of Hurricane Hazel as it passed through the North Carolina coast on October 15, 1954, illustrates the damages a hurricane can cause in coastal communities. Hazel made landfall and began its path of destruction at Little River, South Carolina. Wind velocities were estimated at 140 miles per hour, and the storm surge exceeded 14 feet; Hazel ranks as a 4 on the Saffir/Simpson Scale. Every fishing pier was destroyed from Myrtle Beach, South Carolina, to Cedar Island, North Carolina -- a distance of 170 miles (Dunn and Miller, 1960, p. 251). On Ocean Isle, North Carolina, all people were evacuated, but all buildings were destoyed, as were all 200 buildings at Holden Beach. At Long Beach, 352 of 357 homes were lost. In Carolina Beach, 475

Figure 2.7: Percentage Probability that a Hurricane (winds exceeding 73 mph) or a Great Hurricane (winds exceeding 125 mph) Will Strike a 50-Mile Segment of the U. S. Coastline in Any Given Year.



Source: Office of Coastal Zone Management, 1976, p. II-8.

buildings were totally destroyed, and 1,365 suffered damages. Over 100,000 cubic yards of sand were deposited on the streets of Carolina Beach due to flooding, wave action, and high winds (Dunn and Miller, 1960, p. 252). Wrightsville Beach was submerged in five feet of water; 89 homes were lost there. A total of 19 people died that day. The number could easily have been much higher.

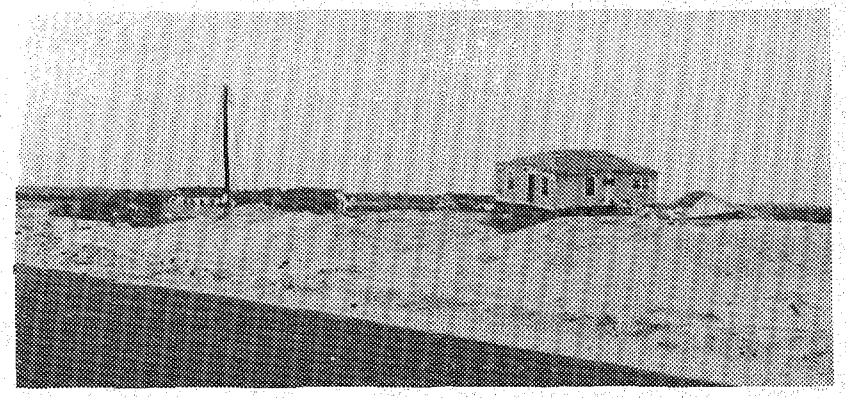
The total damage caused by Hurricane Hazel was $125,309,000 (N.C. Council on Civil Defense, 1955, p. 21). Because Hazel arrived after harvest time, damage to crops was relatively light, but damage to farm buildings exceeded $50,000,000. Damages to forests totaled $3,000,000. Damages to the fishing industry were approximately $1,500,000. Costs of repairs and replacements of public highways were one-half million dollars. Damage to municipal and county public facilities exceeded $8,000,000. Four thousand homes and 1,000 commercial and industrial buildings were completely destroyed or suffered major damage. Minor damage was sustained by 20,000 dwellings and 4,000 business and industrial buildings and amounted to about $60,000,000. Damages to churches and public schools were estimated at one million dollars.

Northeasters (Extratropical Winter Storms)

In addition to the hurricane threat, North Carolina experiences in the winter and early spring a progression of extratropical cyclones, generally moving from west to east across the middle latitudes. Forming outside of the tropics, these storms -- called northeasters -- can have impacts on coastal communities similar to those or hurricanes.

Unlike hurricanes, which pass over a coastal community in several hours, a northeaster may last in an area for several days. Precipitation may or may not be associated with these storms. Their primary impact comes from the force exerted on the water surface by continuous high winds. This generates intensive and heightened wave action, which increases beach erosion. An extreme northeaster may even generate a storm surge, causing extensive flooding and bringing wave action inland. While the storm surge accompanying hurricanes generally recedes after one or two high tides, the surge from a persistant northeaster may last for four or five successive high tides. The highest tides and strongest winds in a northeaster occur farther from the storm's low pressure center than in a hurricane; thus, a northeaster can cause widespread damage even though its center is several hundred miles at sea.

Appendix A lists the most severe extratropical storms that have affected North Carolina in the twentieth century. The "Ash Wednesday Storm," which struck North Carolina in March of 1962, caused extensive damage in Dare County. Many of the area's protective sand dunes were knocked flat by a storm surge and waves totalling over 20 feet above mean sea level. Roads were washed out, and a 200-foot-wide inlet was cut across Hatteras Island at Buxton. Two deaths and approximately 12 million dollars in damages were reported (Baker, 1978, p. 76).

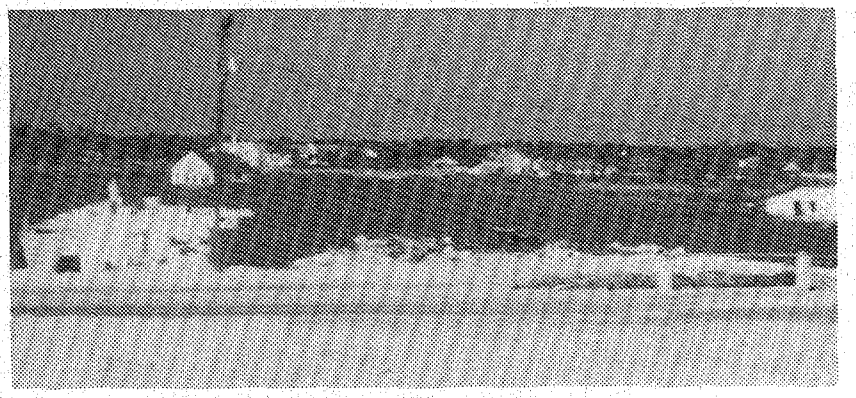


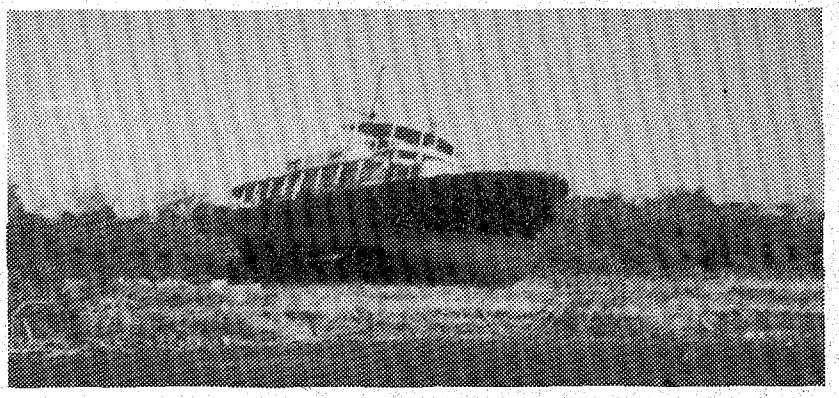
Hazel ravaged Long Beach, destroying nearly everything on the island.

(Courtesy of N. C. Div. of Archives and History)

Homes in Wrightsville Beach were swept into the sound.

(Courtesy of N. C. Office of Coastal Management)





The storm surge and waves left boats high and dry.

(Courtesy of N. C. Office of Coastal Management)

This elevated home in Wrightsville Beach fared well compared to adjacent homes.

(Courtesy of N. C. Office of Coastal Management)

Table 2.2: Population Growth in Coastal North Carolina (1950-1980)

County -Oceanfront Town	1980	1970	1960	1950
Beaufort	40,385	35,980	36,014	37,134
Bertie	40,918	20,528	24,350	26,439
Brunswick	35,777	24,223	20,278	19,238
-Caswell Beach	110	28	NA	NA
-Holden Beach	232	136	NA	NA
-Long Beach	1,844	493	102	NA
-Ocean Isle	438	78	5	NA
-Sunset Beach	304	108	NA	NA
Camden	5,820	5,453	5,598	5,223
Carteret	40,794	31,603	27,438	23,059
-Atlantic Beach	941	300	76	49
-Emerald Isle	865	122	14	NA
-Pine Knoll Shores	646	62	NA	NA
Chowan	12,497	10,764	11,729	12,540
Craven	70,631	62,554	58,773	48,823
Currituck	11,089	6,976	6,601	6,201
Dare	13,377	6,995	5,935	5,405
-Kill Devil Hills	1,796	357	268	NA
-Nags Head	1,020	414	NA	NA
-Southern Shores	395	75	NA	NA
Gates	8,875	8,524	9,254	9,555
Hertford	23,368	23,529	22,718	21,453
Hyde	5,873	5,571	5,765	6,479
New Hanover	103,471	82,996	71,742	63,272
-Carolina Beach	2,000	1,663	1,192	1,080
-Kure Beach	611	394	293	228
-Wrightsville Beach	2,910	1,701	723	711
Onslow	112,784	103,126	86,208	42,047
Pamlico	10,337	9,467	9,850	9,993
Pasquotank	28,326	26,824	25,630	24,347
Pender	22,215	18,149	18,508	18,423
-Surf City	391	166	NA	NA
-Topsail Beach	264	108	NA	NA
Perquimans	9,466	8,351	9,178	9,602
Tyrrell	3,988	3,806	4,520	5,048
Washington	14,801	14,038	13,488	13,180
Total	614,792	509,457	473,577	407,461
% Change	21%	8%	16%	---
Oceanfront Counties*	345,380	279,639	242,475	184,124
% Change	24%	15%	32%	---
North Carolina	5,880,000	5,080,000	4,560,000	4,060,000
% Change	16%	11%	12%	---

*Currituck, Dare, Hyde, Carteret, Onslow, Pender, New Hanover, Brunswick

Trends in Coastal Development

Hurricane Hazel was the most damaging hurricane to strike the North Carolina coast to date, but it is far from the worst possible scenario. Population growth along the North Carolina coast since Hurricane Hazel and the Ash Wednesday storm has been substantial. The towns of Wrightsville Beach, Long Beach, and Ocean Isle have collectively grown from a population of 830 in 1960 to 5,192 in 1980. A hurricane of Hazel's magnitude passing along the same path today as in 1954 would affect a much greater population and could be expected to cause much greater damage. The same is true for a northeaster similar to the Ash Wednesday storm.

Since 1950, the population in the 20 coastal counties has grown by 51 percent (see Table 2.2), from 407,461 to 614,792. The oceanfront counties (Currituck, Dare, Hyde, Carteret, Onslow, Pender, New Hanover, and Brunswick) have grown 88 percent, from a combined population of 184,124 in 1950 to 345,380 in 1980; furthermore, this rate of growth is expected to continue or increase (see Table 2.3).

Table 2.3: Population Projections for the Eight Oceanfront Counties

County	1980[1]	2000[2]
Brunswick	35,777	85,002
Carteret	40,794	67,268
Currituck	11,089	35,164
Dare	13,377	51,378
Hyde	5,873	6,966
New Hanover	103,471	157,021
Onslow	112,784	120,680
Pender	22,215	33,441

[1]U.S. Bureau of the Census, April 1982.
[2]N.C. 2000 - Office of State Budget and Management Projections.

In addition to these increases in year-round population, coastal communities in North Carolina have experienced a surge in second-home development and tourist populations over the past twenty years. These increases swell the potential for hurricane damages and loss of life even further. This concentration of people and development in hurricane-prone communities since the last time a major hurricane hit North Carolina points toward the need for local officials to address the hurricane threat and reassess the policies and measures that are now in place to reduce the risk of storm damages.

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CHAPTER 3:

MITIGATING THE HURRICANE HAZARD

Community activities regarding natural disasters fall into four basic phases: mitigation, preparedness, response, and recovery. These four phases are related; while they often overlap, they roughly follow each other in a cycle from one disaster to the next (see Figure 3.1).

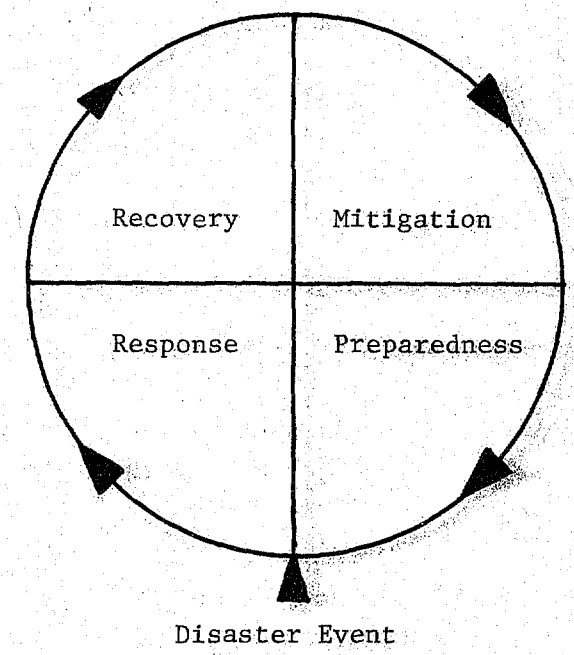


Figure 3.1: The Four Phases of Disaster-related Activity

Mitigation involves activities which reduce the probability that a disaster will occur and minimize the damage caused by a disaster. Such activities can range from the establishment of a nationwide hurricane tracking system to the adoption of local land use regulations which discourage residential construction in flood-prone areas. Mitigation activities are not geared to a specific disaster; they result from a long-term concern for avoiding the damages of future natural disasters.

Preparedness activities immediately precede a particular disaster. While mitigation helps a community avoid certain damages, preparedness helps a community cope with unavoidable and immediate threats to life and property and enhances disaster response operations. Preparedness involves a good deal of planning (such as the development of evacuation and emergency operations plans) that is not tailored to a specific impending disaster. In this way, it overlaps with mitigation. Preparedness also involves more immediate steps, such as issuing hurricane warnings, evacuating people from flood-prone areas, and operating temporary disaster shelters.

Response activities immediately follow a particular disaster. These include search and rescue operations, providing temporary housing and emergency medical care, temporarily shutting down damaged utilities, and assessing damages. Response activities assist those injured by the disaster, reduce the probability of "secondary" damages (such as from broken electrical lines), and set the community on the road to recovery.

Recovery involves the full range of rehabilitation and reconstruction activities which seek to return the community to "normal." These include financial assistance to cover property damages, economic recovery plans, reassessment of the community's land development policies, and the repair, reconstruction, and relocation of damaged structures and utility systems. In returning all systems in the community to pre-disaster or improved operating levels, recovery activities may or may not be consistent with a community's pre-disaster development plans and may or may not include mitigation measures which protect the community against future disasters. Recovery activities may continue for years after a particular disaster. Depending on the extent of damage and other factors, a community might never achieve full recovery.

EMERGENCY MANAGEMENT AND DEVELOPMENT MANAGEMENT FUNCTIONS OF LOCAL GOVERNMENT

Operating throughout this four-phase cycle of activities are two distinct government functions: emergency management and development management. Both are part of a community's comprehensive planning process, though they typically operate independently of one another.

Emergency management deals primarily with activities during the preparedness and response phases which immediately precede and follow a specific disaster. Its focus is the improvement of operations in the face of disaster by providing a framework in which decisions can be made on-the-spot and carried out smoothly and quickly as the community faces massive disruption.

Development management primarily deals with activities during the mitigation and recovery phases, where the community deals with longer-term, more general concerns. Its focus is the improvement of conditions in the face of disaster by providing a set of guidelines for development which maintains or improves the economic well-being of the community, protects the lives and property of its residents, and preserves the integrity of its natural environment.

Emergency management and development management require somewhat different skills. The preparedness and response phases require more tactical skills (National Governors' Association, 1978, pp. 113-114), where different actors follow pre-designated procedures to ensure smooth operations during an emergency. Mitigation and recovery require more strategic skills, where the community sets long-range objectives and designs specific policies and other measures to achieve them. While emergency management and development management each involve tactical and strategic skills, tactical skills predominate in the emergency management field and strategic skills predominate in the development management field.

Unfortunately, most communities do not coordinate their emergency management activities with their development management activities. Immediately after a natural disaster, long-term concerns are usually dominated by short-term concerns in the community's understandable desire to return to "normal" (the pre-disaster state) as quickly as possible. Emergency management has traditionally focused on these short-term concerns: warning people of an approaching disaster, evacuating them from endangered areas, assessing the damages, and quickly rebuilding the community. Until recently, the emergency management field afforded little (if any) attention to long-term concerns by integrating post-disaster reconstruction into the community's pre-disaster development plans or by instituting measures to mitigate the effects of future disasters. Development management influences the location, character, and timing of land development in a community in accordance with a set of short-term and long-term community objectives. It therefore has an obvious stake in the redevelopment patterns which occur after a natural disaster. It also offers a variety of tools (land use regulations, building codes, etc.) for mitigating the effects of future natural disasters.

Since a community's planning personnel (or "development managers") and emergency operations personnel (or "emergency managers") have different approaches and primary missions, they usually do not work together to minimize the risk of disaster in the community. (This has tended to be the case among state and federal agencies as well.) However, planners and emergency managers can offer valuable guidance to each other in determining how the community can best avoid the loss of life and property. In managing development with an eye toward hazard mitigation, planners need to bring emergency operations personnel into the planning process. Emergency operations personnel can make development management more effective by pointing out problems or problem-solving approaches that planners may have overlooked. Proper development management can likewise make emergency operations easier; when there is less damage in the community, emergency managers must overcome less disruption and handle fewer cases of death and property loss.

THE INCREASING EMPHASIS ON HAZARD MITIGATION

Reducing the risk of damages from natural disasters has always been a part of local planning and policymaking. Hazard mitigation falls under the local government's responsibility to protect the public health, safety, and general welfare. In turn, many local and state governments throughout the United States have responded to natural hazards, especially flooding and high winds, by delineating hazardous areas and by instituting land use controls, construction standards, and public investment policies governing development within those areas.

Most local mitigation efforts to date have used the local powers of zoning and subdivision regulation to control the character of development in flood-prone lands. For example, in 1969, in response to Hurricane Camille, Jackson County, Mississippi, instituted a floodplain district which restricts land to open space uses or uses elevated to 12.5 feet above mean sea level. In 1957, Warwick, Rhode Island, instituted a two-district zoning ordinance for hurricane-prone areas. In areas of "extreme danger," the ordinance permits only open space uses; in areas of "lesser danger," the ordinance requires the first floor of a building designed for overnight occupation to be

15 feet above mean sea level. In 1969, Edenton, North Carolina, instituted a floodplain zone, limiting uses to agriculture and single-family residences. (U.S. Water Resources Council, 1972, vol. 2, appx. C.)

Building codes have long been used by local and state governments to reduce the risk of damages from flooding and high winds by setting standards for flood-proofing, elevation, and wind resistance. For example, in 1967, Corpus Christi, Texas, adopted a building code requiring all structures to have a minimum floor elevation of seven feet above mean sea level. In 1955, Wrightsville Beach, North Carolina, adopted a code requiring buildings to be elevated on piles eight feet above mean high water; the code also governs the depth, spacing, size, tying, and bracing of piles. (U.S. Water Resources Council, 1972, vol. 2, appx. C.) Wind-resistance standards appear in most state and local building codes, establishing some "design wind speed" which a structure must be able to withstand. The North Carolina State Building Code establishes "basic design wind velocities" of 110 to 120 miles per hour for the state's oceanfront counties. These velocities were adopted in response to the North Carolina coast's exposure to and experience with hurricanes.

Local governments also have used a variety of other ordinances to reduce the risk of damages from hurricanes and other coastal hazards. Such ordinances include shoreline setbacks, standards for the construction of seawalls and other erosion protection works, and requirements for preserving key natural environments. While mitigating the hurricane hazard is not always the primary goal of these ordinances, they do provide some protection. Shoreline setbacks can distance buildings from erosion by waves and currents. Seawall standards can keep erosion protection works from becoming projectiles during a major storm or accelerating the erosion of adjacent properties. Environmental protection ordinances can preserve frontal dunes, wetlands, and other landforms that provide the community with a degree of natural protection from hurricane forces.

Despite the policies mentioned above, local government efforts to mitigate the hurricane hazard have, overall, been piecemeal and uncoordinated. Local governments have often lacked the authority or resources to deal with different aspects of the hurricane threat and have relied on state and federal programs to mitigate the hazard. At the same time, economic and political forces, state and federal aid for public works construction, and federal disaster relief programs have often led local governments to ignore the hurricane threat and allow (or encourage) development to occur unimpeded in hazardous areas. The tenure of local government officials is usually shorter than the amount of time between hurricanes and other major storms which strike the community; therefore, local officials often perceive hurricanes as being much less of a threat to the community than they actually are.

As a result, coastal development continues at a pace that exposes ever-increasing numbers of people and properties to the forces of hurricanes. Property losses due to hurricanes continue to climb despite the establishment of hurricane warning systems, evacuation plans, and seawalls. All of this points to the need for a coordinated local effort to control the location and quality of development in coastal hazard areas. Many of North Carolina's coastal communities have made concerted efforts to reduce the risk of hurricane damages in the past (largely in response to the hurricanes of the 1950s

and 1960s) and continue to do so today (largely in response to the National Flood Insurance Program and the State's Coastal Area Management Act).

The National Flood Insurance Program was the first broad-scale, nationwide program to mitigate natural disasters by guiding the location and quality of development in hazardous areas. With the National Flood Insurance Act of 1968 (Public Law 90-448), Congress established the program to reduce ever-increasing annual flood losses through more careful planning of flood-prone areas and to provide property owners in those areas with affordable insurance against flood damages. The program, which is administered by the Federal Emergency Management Agency's Federal Insurance Administration (FIA), offers flood insurance to property owners in designated flood hazard areas. In return, local and state governments enact and enforce comprehensive floodplain management measures to protect lives and new construction from future flooding. These floodplain management measures involve land use controls and construction standards, as well as other techniques, applied within flood-prone sections of a community. The program's main purpose is to reduce the amount of developed property exposed to flooding; it reflects the realization that "non-structural" measures are just as important as (and perhaps more effective than) "structural" measures in mitigating flood damages. Even though many critics claim that the National Flood Insurance Program has actually accelerated oceanfront development, it has also stimulated the adoption of local and state measures to reduce the risk of flood damages.

The past few years have also brought increased attention to mitigating hurricane hazards in federal development assistance and disaster assistance programs. Until the late 1970s, federal programs paid little heed to the recurrent hazards present in flood-prone areas. Federal development assistance programs funded the construction of facilities (water lines, sewer lines, roads, public buildings, etc.) in flood-prone areas. Federal disaster assistance programs provided aid for communities to rebuild only to the same conditions that existed before the disaster, with no measures taken for future protection. Recent administrative and legislative directives have begun to change these policies.

In 1977, President Carter issued Executive Order 11988--Floodplain Management--calling for all federal agencies to avoid directly and indirectly supporting future unwise development in floodplains. The order also advocates protecting floodplains for their natural values. Another order issued during the Carter administration requires all federal agencies (especially the Army Corps of Engineers) to consider "non-structural" alternatives in planning flood protection projects.

In 1980, the primary federal agencies which provide construction funds and disaster relief aid signed an "Interagency Agreement on Non-structural Flood Damage Reduction Measures." The agreement addresses flood damage reduction, pre-disaster planning, and post-disaster recovery activities. The agreement states, as a common policy, that post-disaster relief activities should prevent future losses and help disaster victims relocate out of high hazard areas rather than rebuild the community to its prior, more vulnerable state. The agreement also encourages pre-disaster planning to reduce future losses, with special attention to flood-proofing actions and "non-structural" measures (such as development regulations and relocation).

The Interagency Agreement also establishes "Interagency Regional Hazard Mitigation Teams" for each of the ten federal regions to recommend specific mitigation measures in disaster-stricken communities. As part of the community recovery effort, the team conducts an on-site analysis of mitigation opportunities and completes a "Hazard Mitigation Report" which recommends detailed mitigation measures and outlines how the disaster assistance available from each federal agency should be coordinated to carry them out.

The Federal Emergency Management Agency has recently begun to more vigorously pursue two elements of the National Flood Insurance Program which provide for the purchase of damaged properties and the relocation of structures out of flood-prone areas. The "constructive total loss" approach of settling flood insurance claims occurs when a property is not totally destroyed but has lost all economic value. The process begins when the community takes such action as prohibiting the reconstruction of damaged buildings in areas with a high probability of future flooding. The Federal Insurance Administration can then declare a damaged property a "constructive total loss" and pay the property owner his/her full insurance claim. The owner can then rebuild on a site outside the flood hazard area and dedicate the original site to the community for use as open space. Section 1362 of the National Flood Insurance Act authorizes the Federal Insurance Administration to purchase insured properties that have been seriously damaged by flooding and to convey ownership to local and state agencies. The local government must guarantee that the site will remain dedicated to open space uses.

Another recent policy change within FEMA should stimulate local and state governments to plan for reducing hurricane damages before a disaster occurs. In the past, FEMA would provide the community with 100 percent of the funds needed to rebuild damaged public facilities. It is now standard practice for FEMA to require the local and state governments to provide 25 percent of the funds. This shifts some of the burden of reconstruction back to the community. Even though the 25 percent match can come from funds from other federal and state aid programs, using them for reconstruction would deny the community the use of these funds for other important purposes. If the community fails to consider hurricane hazards in the location and design of public buildings and utility systems, it could face a serious fiscal drain after a hurricane strikes.

Concern for mitigating hurricane hazards in North Carolina has shown a marked increase recently within the state government. After the hurricanes of the 1950s and early 1960s, there was a flurry of concern and activity in North Carolina for reducing potential hurricane damages; witness the long-time inclusion of high wind-resistance standards in the N. C. State Building Code. However, state government activities in the past ten years (a period of little hurricane activity) have spurred a better understanding of coastal hazards and the formulation of more coordinated and comprehensive means of dealing with them. These activities include those of the Coastal Resources Commission and Office of Coastal Management (Department of Natural Resources and Community Development) and those of the Division of Emergency Management (Department of Crime Control and Public Safety).

The overall mission of the Coastal Resources Commission and the Office of Coastal Management, as outlined in the Coastal Area Management Act of 1974 (CAMA), is to promote the wise development of the state's coastal

resources. The CAMA program has two key elements: the development and adoption of land use plans by local governments in the 20 coastal counties and the regulation of development within designated areas of environmental concern (AECs). The local land use plans identify local development needs and ways to fulfill them; many of the local plans specifically address the need to mitigate coastal hazards. The AEC permit system, administered jointly by the local governments and the state, considers natural hazards in the designation of specific AECs, such as "ocean erodible areas," "inlet hazard areas," and oceanfront "flood hazard areas". In addition, the Coastal Resources Commission convened a special Post-disaster Task Force in 1981 to examine ways that coastal communities can avoid future hurricane damages and to formulate policies for meeting this goal.

The Division of Emergency Management is responsible for coordinating disaster preparedness and response activities throughout North Carolina. One of its major activities since the late 1970s has been to develop hurricane evacuation plans to safeguard the lives of coastal residents and visitors. The adoption of local evacuation plans has led to doubts about the ability of some communities to safely evacuate and to avoid future losses of life and property. These doubts arise from a combination of four factors: the lack of public awareness, the level and pace of development in the community, the traffic capacity of evacuation routes, and the amount of warning time available. While the evacuation planning is aimed at reducing the loss of lives, it has created a greater awareness of the total threat hurricanes present to life and property. The Division of Emergency Management is also working to have each county in the state prepare a local disaster relief and assistance plan to outline procedures for emergency communications, emergency shelter operations, damage assessments, and other disaster response activities.

Local government action, in response to local experience with coastal storms and development and in response to state and federal hazard mitigation programs, is especially important. The emphasis on mitigating the hurricane hazard through managing coastal development is growing at all levels of government: local, state, and federal. A variety of opportunities and techniques currently exist for local governments in North Carolina to reduce the risk of future hurricane damages. Hazard mitigation is an important responsibility of local government, which should guarantee the safe location and design of coastal development.

HAZARD MITIGATION--AN INTRODUCTION TO THE ISSUES

Mitigation and New Development

Hazard mitigation should be a guidepost for local decisions regarding new development, be it private development or public facilities. As the community grows, it must protect itself from future disasters. It must encourage designing development to withstand hurricane forces, encourage locating development away from high hazard zones, or pursue some combination of the two.

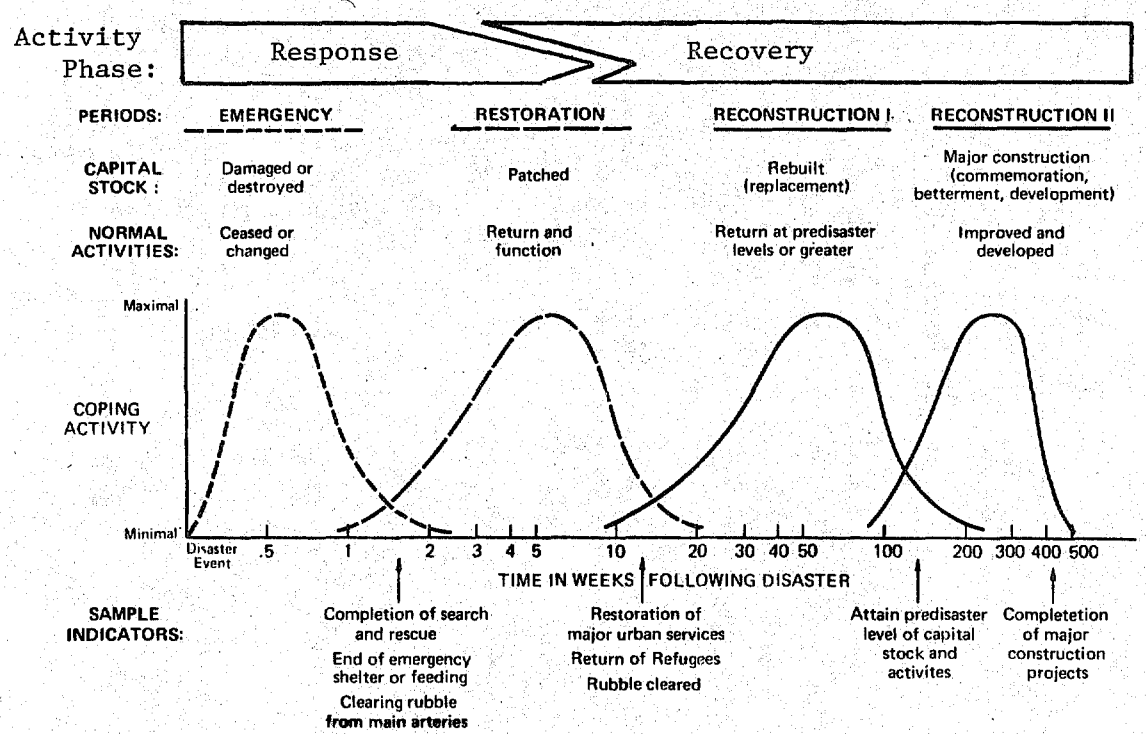
A community can use the variety of tools discussed in the next chapter to guarantee that new development is relatively safe from hurricanes. Most of these tools (such as zoning regulations and building codes) are traditional and common components of local government decision-making. Others are necessarily non-traditional to deal with the unique characteristics of hurricanes and the unique conditions which exist in each community.

In using these tools, a local government will always face a conflict in community values; certain issues will arise, just as they do in all other local government decisions. Local officials will have to walk the fine line between the "reasonable" protection of the public health, safety, and general welfare and the "unreasonable" infringement of private property rights and individual risk-taking. Some people in the community will claim that the protections adopted by the local government are prohibitively costly. Nonetheless, coastal communities must protect themselves from future disasters and the psychological and economic burdens they bring. Each community can find a feasible approach, suited to local conditions, for reducing the risk of future hurricane damages.

Mitigation and Post-disaster Reconstruction

According to well-documented research, the reconstruction process occurs in four periods which overlap yet follow each other in sequence after a disaster strikes (Haas et al., 1979, pp. xxvii-xxviii). Figure 3.2 shows the sequence and time frame within which these four periods operate; note that each period overlaps with the next and that they cover both the response and recovery phases presented in Figure 3.1.

Figure 3.2: The Four Stages of Reconstruction



Adapted from Haas et al., 1977, p. 4.

The emergency period covers the first days or weeks after the disaster, when social and economic activities are most seriously disrupted and attention focuses on the dead, injured, missing, and homeless. The restoration period covers the first weeks or months after the disaster, when attention focuses on debris removal and the rapid repair of damaged utilities, housing, and commercial structures. The restoration period marks the transition from the response phase to the recovery phase. The replacement reconstruction period (also known as Reconstruction I) concentrates on reconstructing, to predisaster levels or greater, those buildings and utilities which were damaged beyond repair. This stage begins several weeks after the disaster and may last for several years. The replacement reconstruction period ends when population, employment, and services reach pre-disaster levels. This may be followed by a commemorative, betterment, and developmental reconstruction period (or Reconstruction II) which occurs several years after the disaster to memorialize the disaster, to mark the community's post-disaster improvement, and/or to enhance future growth.

The actual amount of time it takes for a community to recover from a natural disaster may be considerably longer or shorter than that shown in Figure 3.2. Some communities never recover fully from a disaster. The key factors influencing the rate of recovery are (in rough order of their importance) the extent of damages, pre-disaster trends of growth or decline, the level of organization and leadership in community decision-making, and the resources (financial, material, and human) available for reconstruction.

The extent of damages has the strongest impact on a community's ability to recover from disaster (Haas et al., 1977, p. 12); a town that loses sixty percent of its capital stock (homes and businesses) will tend to recover more slowly than a town that loses ten percent. Pre-disaster trends of growth or decline in a community tend to be accelerated by a disaster; rapidly-growing areas recover more quickly than declining areas (Haas et al., 1977, p. 19). This acceleration of past trends will also occur among different sections of the same community; after the tornado in Xenia, Ohio, stronger neighborhoods rebuilt at a fast pace while declining neighborhoods did not rebuild at all (Francaviglia, 1978, p. 20). Leadership and organization are important in that they reduce uncertainty after a disaster and expedite the decisions necessary for recovery (Haas et al., 1977, pp. 19-20). Shortages of financial, material, and human resources will undoubtedly hamper a community's recovery efforts; however, the availability of resources alone is not a prime factor in determining the rate or extent of reconstruction (Haas et al., 1977, pp. 18-19).

The reconstruction strategies that a community should pursue after a disaster are seldom clearly defined. The recovery phase (that is, the restoration period and the two reconstruction periods) is typically marked by tension between three forces or sets of values within the community: that pressing for an immediate return to "normalcy," that pressing for a reduction of future vulnerability, and that pressing to seize opportunities for improved efficiency, equity, and attractiveness (Haas et al., 1977, p. xxvi). Further complications arise because each set of values will have proponents in each of the three sets of actors which play a role in recovery decision-making: residents, business people, and government administrators. Coalitions which existed before the disaster may or may not continue after the disaster, depending on the new conditions facing individuals or interest

groups within the community.

Some people in the community (especially those whose homes or businesses are severely damaged or destroyed) will want to rebuild to pre-disaster conditions as soon as possible, whether or not the reconstruction includes safeguards against future disasters. This is quite understandable; people long for a return to familiar surroundings when they face massive social and economic insecurity. Even for those who suffered little or no damages, having families occupying temporary quarters and businesses operating out of patched-up or temporary locations are constant reminders that the situation is unsatisfactory, still not back to normal (Haas et al., 1977, p. 43).

Some people in the community (including some whose homes and businesses are damaged or destroyed) will press for the institution of mitigation measures during reconstruction to help the community avoid past mistakes and minimize the damage of the next disaster. Such measures might include more stringent development management policies. These people are not necessarily against rapid reconstruction; they are for safer reconstruction. Nonetheless, deciding on which measures to institute takes time, unless the community decided on them before the disaster struck. The drive for reconstruction to "normal" conditions can easily overcome and outpace the drive for hazard mitigation, leaving the community no safer from disaster.

Some people in the community will see the recovery phase as an unparalleled opportunity to rebuild the community in a fashion that will be more efficient (from the standpoint of merchants and public service administrators), more equitable, and more attractive. The proponents of this set of values may operate out of self-interest or out of a concern for the total community well-being. The disaster may create an opportunity for pursuing projects that were proposed before the disaster (such as public works or business renovations). Some businesses whose losses were minimal may see a competitive advantage if competitors were severely damaged (Haas et al., 1977, p. 43). Some homeowners may have a vested interest in not having "less-desirable" neighborhoods rebuilt.

Some individuals in the community will fall into more than one of the camps described above. For example, just about everyone will want to see the community reconstructed as quickly as possible. Expediency is the key force; the community will begin rebuilding with or without specific guidelines. The private sector, using whatever resources it can, will act more quickly than government administrators. The struggle between the various forces operating in the community produces a greater tendency toward poorly-planned, yet rapid, reconstruction than it does toward carefully-planned, yet slow, reconstruction. Unless a community prepares itself before the disaster (carefully assessing hazards in the community, taking appropriate mitigation measures, and establishing guidelines for new development and redevelopment), it can expect to continue suffering damages from one disaster to the next.

These often-conflicting forces give rise to seven basic issues during the recovery phase (Haas et al., 1977, pp. 44-59):

1. Should there be changes in land use?

When particular sections of a community are severely damaged by a disaster, land use decisions are the most important ones a local government faces. These decisions can have a far-reaching impact by changing the face of the community and its opportunities for redevelopment and future growth. Suggestions for changing land use patterns (by relocating damaged structures and utilities or by redesigning land development policies) primarily come from those people who want the community to rebuild in a safer fashion. Some people will also see land use changes as an opportunity to improve the community's attractiveness and efficiency.

Relocation of the damaged sections of a community offers the best opportunity to improve the land use pattern; however, such relocation is not always politically and economically feasible. Again, the desire for "normalcy" plays a dominant role. Rebuilding in the high-risk area may be the most economical choice for a resident, merchant, or public works administrator who already owns the land and may not be able to get adequate disaster assistance or insurance payments to finance relocation. For example, the Federal Emergency Management Agency will fund 75 percent of the cost of rebuilding public facilities as they were. If a community chooses to relocate these damaged facilities, it must bear the costs (such as land acquisition) above and beyond replacement. Land acquisition costs usually make relocation more expensive than reconstruction at the original site. The decision to relocate sections of the community is further complicated when homes are destroyed, but water and sewer lines sustain little damage. To facilitate relocation, the community must be able to delineate hazard areas where reconstruction should be avoided, find suitable vacant land to accommodate reconstruction, and arrange transfers of property ownership.

The longer it takes for a community to resolve the land use issue, the greater is the chance that people will act independently and quickly rebuild in the former, more familiar pattern. If land use changes are to occur after a disaster to make the community safer, more efficient, or more attractive, the local government must institute them rapidly. Preparing a set of post-disaster land development guidelines before disaster strikes will help the community resolve these issues beforehand, make quick and sound decisions immediately after the disaster, and recover smoothly from the damages.

2. Should there be changes in the building code?

Safe reconstruction can occur on hazardous parcels of land if buildings are designed to withstand flood waters, high winds, and wave action. A natural disaster provides the opportunity for testing whether or not the community's building code is adequate to reasonably protect residential, commercial, and public structures. A community must decide whether it should maintain the building code as is, or amend it to deal with unforeseen problems. As with land use changes, building code decisions need to be made quickly (or before the disaster) if they are to have any effect on the community's future safety. Few people will want to delay reconstruction until new building standards are developed. Building code decisions will involve an economic choice, balancing the cost of disaster-proofing measures and the level of risk perceived by community residents; thus, no structure in a hazard area will be absolutely immune from future damage.

3. Should there be a concerted effort to make the community more efficient and more attractive?

This issue is closely related to the land use and building code issues and arises where extensive damages create the possibility for relocating or redesigning transportation and utility networks and residential and commercial structures. While such changes may occur normally at a slow pace without a disaster occurring, a disaster will lead some people to reassess the overall fabric of the community and attempt to significantly alter the course of its development. Such post-disaster improvements will take place incrementally and will be molded by compromise; large-scale plans for alteration will seldom be followed because of the years it takes to develop and implement them.

4. Should there be compensation or special financial assistance for private property losses?

Major disasters lead to federal, state, and other outside financial aid being made available to those suffering property damages. Much controversy is likely to surround who should get aid, how much, and for what purposes. For example, if outside agencies provide reconstruction grants and low-interest loans with no attempt to follow local hazard mitigation guidelines, the community will be no safer from disaster than it was before. These guidelines and stipulations are controlled by the policies of the agency providing the funds, even though they will have a strong influence on the level, character, and speed of community recovery.

5. How should increased local public expenditures be financed?

The repair and reconstruction of damaged roads, utilities, and public buildings after a disaster will substantially increase local government expenditures while property damages and reduced business activity will decrease the flow of local tax revenues. Land acquisition and the enforcement of land use regulations and building codes during reconstruction could add an additional burden just as local government resources are being stretched to their limit. Even though federal and state aid will be provided to severely-stricken communities, the local government will face a financial burden that influences its recovery. Local government officials may have to reassess and restructure the community's taxation and budgeting policies--a procedure which creates controversy with or without a disaster occurring.

6. Should normal or extraordinary decision-making mechanisms be used to guide post-disaster recovery?

The disruption and ensuing indecision that a disaster imposes on a community will create conflict over the way recovery decisions should be made. While the desire for a return to normalcy may support the use of normal government planning and administrative procedures, the extraordinary nature of disasters and the need for quick decisions may create pressure to institute alternative procedures for expediting recovery. Such mechanisms may include the appointment of a special task force, with special powers, which can override normal procedures and avoid delays in redevelopment. They might also include a set of pre-prepared guidelines for reconstruction

which automatically go into effect when disaster strikes. Different parties in the community will see an opportunity to change the way local government decisions are made and to mold reconstruction in different ways. Unless there exists some way to reach quick compromises after the disaster or to resolve key issues before the disaster, the community is not likely to undergo a speedy recovery.

7. How should disaster-produced personal and family problems be handled?

People face a great deal of stress after a disaster. Their homes and workplaces are damaged or destroyed. They face uncertainty and economic hardship, which create emotional problems. While insurance payments and disaster relief aid can remove some of the economic hardship, emotional strain will persist as disaster victims must adapt to different living quarters and different economic conditions. Community leaders must recognize and treat this stress throughout the recovery process.

All of the issues outlined above are interrelated; some issues must be resolved before others and some will be resolved simultaneously. For example, decisions on the reconstruction and relocation of homes, businesses, and utilities will influence the local government's fiscal planning and the amount of financial assistance needed by disaster victims. Depending on the conditions left by the disaster, certain issues will be more apparent and more critical; not all issues will demand or receive equal attention. Some issues may not be resolved within a reasonable time period to ensure that community recovery is smooth and coordinated. Unfortunately, delay is the norm rather than the exception.

Most communities already have guidelines for reconstruction in their land use regulations and building codes. These guidelines apply to "non-conforming" land uses and to structures which were built before the building code was adopted. They typically stipulate that when a property is damaged beyond a certain percentage of its market value, it must comply with existing land use and construction standards whether or not these standards allow the owner to rebuild on the same site. Communities need to pay more attention to such common tools in adopting measures to reduce future damages.

Most of the issues which arise during the recovery phase also arise during the mitigation phase. Just as a community must decide on standards for reconstruction, so must it decide on standards for new and existing construction. In each case, a local government must address both technical problems (such as administering local development ordinances, adequately inspecting new construction, and accurately assessing storm damages) and political problems (such as deciding what level of risk to protect against and what measures to take in managing new development and reconstruction to reduce the potential for storm damages).

Recovery efforts will be enhanced if key issues are resolved before the disaster strikes. Herein lies the link between disaster recovery and hazard mitigation, where mitigation measures adopted before the disaster minimize damages and facilitate recovery, and where reconstruction can build in features which protect the community from future disasters.

Planning Before Disaster Strikes

People don't want to think about hurricanes, but they need to. The institution of mitigation measures will not be easy unless people realize that a high level of hurricane risk exists along the North Carolina coast--a result of the state's exposure to major storms and the rapid development of its coastline. The lack of community consensus regarding the level of risk makes basic issues difficult to resolve either before or after a hurricane strikes. Some residents will perceive a high level of risk and press for mitigation. Other residents will perceive a low level of risk or a level which is outweighed by whatever benefits (immediate cost savings, peace of mind, etc.) they derive from not acting to guard against future damages. Many residents won't think about hurricanes at all. The situation boils down to "out of sight, out of mind"; communities often don't take steps to protect themselves in the long run until a massive disaster actually occurs.

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CHAPTER 4:

TOOLS AND PROGRAMS FOR HURRICANE HAZARD MITIGATION

Regulating development within a community is a primary function of local government, which is responsible for protecting the public health, safety, and general welfare. Local government has available a variety of tools for managing development -- these can help prevent conflicts between adjacent land uses, maintain the community's capacity to absorb new development, and reduce hazards posed by unsafe development practices. Development management tools play a useful and essential role in coastal communities in reducing the risk of damages from flooding, erosion, and high winds.

This section presents the full range of tools which are available to local governments in North Carolina for managing development to reduce the risk of hurricane damages. The tools presented cover the location of development and the quality of construction. They cover post-hurricane reconstruction as well as new development which occurs before the storm. While ultimate responsibility for managing development falls on local government, local government does not operate in a vacuum. State and federal programs are designed to fulfill state and federal goals which local governments may not be equipped to handle. The section opens with a discussion of the state and federal programs which influence private development decisions in hazardous areas and which set the context for local government actions regarding development and post-disaster reconstruction. The section then presents the development management tools and powers available to local governments and how different communities throughout the nation are using these tools to reduce the risk of damages from hurricanes and other major storms.

Homes in Carolina Beach after Hurricane Hazel
(Courtesy of N. C. Div. of Archives and History)

STATE PROGRAMS INFLUENCING LOCAL DEVELOPMENT

The main state programs which address different aspects of development and post-disaster reconstruction with regard to the hurricane hazard are the Coastal Area Management Act (CAMA) and the State Building Code. CAMA addresses the flooding and erosion problems associated with hurricanes through its requirements for development in areas of environmental concern (AECs). The State Building Code addresses the high wind problem associated with hurricanes through its requirements for wind-resistant construction.

Coastal Area Management Act (CAMA)

North Carolina's Coastal Area Management Act of 1974 (CAMA) was adopted by the General Assembly as a result of increasing pressures placed on coastal resources by a growing population, industrial development, and recreational demands. The Act provides two key mechanisms for coordinating resource management to more effectively protect and enhance the use of coastal lands and waters: the formulation of local land use plans and the designation of areas of environmental concern. CAMA establishes a cooperative program between the state and local governments. Local governments are assigned the initiative for planning--developing local land use plans which articulate the objectives of local citizens and their vision of desired development patterns. The Coastal Resources Commission is assigned a supportive standard-setting and review capacity which maintains uniformity in the management of the state's coastal resources--establishing guidelines for local land use plans and for development in areas of environmental concern.

The Coastal Resources Commission, in carrying out its CAMA mandate, has identified four categories of areas of environmental concern (AECs): the estuarine system, ocean hazard areas, public water supplies, and natural and cultural resource areas. Within these critical areas, the Coastal Resources Commission (with its staff, the Office of Coastal Management) administers a permit system to regulate uncontrolled or incompatible development which might result in irreversible damage to property, public health, and the natural environment.

The Coastal Area Management Act divides responsibilities for carrying out the permit program between local governments and the CRC. Individuals proposing "major" developments within AECs must receive permits directly from the CRC; a "major" development is any activity which requires a permit from another state agency, contemplates drilling for or extracting natural resources, occupies an area of more than 20 acres, or proposes structures which occupy a ground area greater than 60,000 square feet. Individuals proposing "minor" developments within AECs must receive permits from the designated local permit officer; a "minor" development is any development which is not classified as "major." The standards determining permit approval are supposed to be identical for both cases. The standards developed by the CRC include lists of uses which are and are not appropriate within the different AECs. (The state guidelines for AECs appear in Title 15, Subchapter 7H of the North Carolina Administrative Code.)

The AEC categories with provisions for mitigating hurricane damages are ocean hazard areas and the estuarine system. A description of these areas follows, including permitted uses and other requirements for development within ocean hazard AECs and estuarine system AECs.

Ocean Hazard AECs--

Ocean hazard AECs are most directly related to hurricane hazard mitigation. These are areas especially vulnerable to erosion and other adverse effects of sand, wind, and water where uncontrolled or incompatible development could unreasonably endanger life or property. "Ocean hazard areas include beaches, frontal dunes, inlet lands, and other areas in which geologic, vegetative, and soil conditions indicate a substantial possibility of excessive erosion or flood damage" (N.C. Adm. Code 15:07H.0301). While presenting a hazard to development placed on them, these landforms also afford natural protection to development located landward of them; this protection of lives and property would be lost if uncontrolled development were allowed to significantly alter the beaches, frontal dunes, and inlet lands. Therefore, regulating development within ocean hazard areas benefits the entire community.

Absolute safety from the destructive forces of the sea is not possible for coastal development; it is also not always feasible or desirable to totally block development within hazardous areas. However, the appropriate siting and design of structures in ocean hazard areas and the protection of oceanfront landforms can greatly reduce the risk to life and property. With this in mind, the Coastal Resources Commission has developed "management policies and standards for ocean hazard areas that serve to eliminate unreasonable danger to life and property and achieve a balance between the financial, safety, and social factors that are involved in hazard area development" (N.C. Adm. Code 15:06H.0303(a)). The CRC's standards, in furthering CAMA's goals, give particular emphasis to "minimizing losses to life and property resulting from storms and long-term erosion, preventing encroachment of permanent structures on public beach areas, and reducing the public costs of inappropriately sited development" (N.C. Adm. Code 15:06H.0303(b)).

The CRC has designated three types of ocean hazard AECs: (1) ocean erodible areas, (2) high hazard flood areas, and (3) inlet hazard areas.

The ocean erodible area is the beachfront zone which exhibits a strong possibility of erosion and shoreline fluctuation. The ocean erodible area includes all land between the mean low water line and the CRC's erosion setback line. The erosion setback line is the distance landward from the first line of stable vegetation determined by multiplying the long-term annual erosion rate for a particular segment of beach by 30 (the average life of a building). In no case shall the erosion setback line be less than 60 feet from the vegetation line. The ocean erodible area also includes a distance landward of the erosion setback line to "the recession line that would be generated by a storm having a one-percent chance of being equalled or exceeded in any given year" (N.C. Adm. Code 15:07H.0304(1)(b)).

The high hazard flood area corresponds to the "V-zones" (V1-V30) which appear on the Federal Insurance Administration's flood insurance rate maps. V-zones are those areas subject to high velocity waters (such as hurricane wave wash) in a one-percent-probability storm (the "base flood"). While V-zones usually lie along the oceanfront, several communities in North Carolina have V-zones along their estuarine shorelines; a storm surge can arise from the state's broad sounds as well as the ocean. However, the CRC's designation of V-zones as AECs applies only to oceanfront V-zones. Where the Federal Insurance Administration has not prepared rate maps for a community, the local government may use base flood elevation data prepared by federal, state, or other sources to delineate the high hazard flood area; the data source must be approved by the CRC. (A more detailed description of the National Flood Insurance Program and its methods of determining coastal flood hazard areas appears later in this section.)

The inlet hazard area, due to its proximity to a dynamic ocean inlet, is especially vulnerable to erosion, flooding, and other adverse natural processes. The inlet hazard area is an extension of the ocean erodible area which encompasses those sites where, based on statistical analysis, the inlet can be expected to migrate. The delineation of an inlet hazard area includes such factors as previous inlet territory, a barrier island's "weak spots" near the inlet (such as overwash fans and unusually narrow areas), and external influences (such as jetties and channelization projects). Maps designating inlet hazard areas must be approved by the CRC.

The Coastal Resources Commission has developed standards for the use of ocean hazard AECs as a guide for state and local permit decisions. The Coastal Resources Commission's "General Use Standards for Ocean Hazard Areas" (N.C. Adm. Code 15:07H.0306) govern development in all three ocean hazard AECs. The standards protect frontal and primary dunes by enforcing the oceanfront setback line, keeping structures behind the crests of frontal and primary dunes, and prohibiting the relocation or removal of these dunes or their vegetation. The standards prohibit publicly-funded facilities (water lines, sewers, roads, etc.) from locating in ocean hazard AECs unless they "(1) clearly exhibit overriding factors of national or state interest and public benefit, (2) will not increase existing hazards or damage natural buffers, (3) will be reasonably safe from flood and erosion related damage, [and] (4) will not promote growth and development in ocean hazard areas" (N.C. Adm. Code 15:06H.0306(c)). The standards prohibit mobile homes from locating in the high hazard flood area (V-zone) unless they are placed in mobile home parks existing as of June 1, 1979. The standards require all relocations of structures within ocean hazard areas to obtain a CAMA permit.

The standards for ocean hazard AECs exempt certain uses from the oceanfront setback requirements. The exempted uses include parking areas with sand or clay surfaces, beach accessways, elevated decks, unenclosed gazebos, and storage sheds. These uses must meet all other standards for development in ocean hazard areas.

Also exempted from the oceanfront setback requirements are lots recorded as of June 1, 1979, where the setback would render the lot unbuildable. This exemption allows permanent structures to be built seaward of the oceanfront setback line as long as certain conditions are met. The structure must still be at least 60 feet landward of the vegetation line, must be entirely behind

the landward toe of the frontal dune, and must be set back on the existing lot the maximum feasible distance from the ocean. The lowest habitable floor of the structure may cover no more than 1,000 square feet or ten percent of the lot's area, whichever is greater. All other standards for ocean hazard areas apply. The exemption pertains only to lots within ocean erodible areas, not to lots within inlet hazard areas.

In addition to the general use standards, development within inlet hazard areas must comply with more stringent standards due to the extreme dangers present there. These specific standards permit permanent residential and commercial structures only at a density of one unit per 15,000 square feet (for lots recorded after July 23, 1981). Single-family units, duplexes, and "readily movable" non-residential structures are the only structures permitted in the inlet hazard area. These must be set back from the shoreline at a distance equal to the setback required in the adjacent ocean erodible area. Shoreline stabilization structures are permitted only as part of a publicly-funded project.

The standards for ocean hazard AECs include guidelines for specific uses or projects; these include ocean shoreline erosion control activities, dune establishment and stabilization, the construction of beach accessways, and new construction and substantial improvements to existing structures. New construction and substantial improvements (increases of 50 percent or more in value or square footage) in ocean hazard AECs must be "designed and placed to minimize damages due to fluctuations in ground elevation and wave action in a 100-year storm" (N.C. Adm. Code 15:07H.0308(d)). Specifically, all new structures and substantial improvements must be elevated to or above the 100-year storm elevation and must comply with Appendix D -- "Windstorm Resistive Construction" -- of the North Carolina Residential Building Code. All pilings (1) must be at least eight inches in diameter (if round) or eight inches on each side (if square), (2) must penetrate more than eight feet below the lowest ground elevation under the structure and, for those structures nearer to the ocean, extend to four feet below sea level, and (3) must be treated to resist insects, decay, and corrosion. All exposed structural connections must be enclosed or rust-proofed. All utility systems must be built to minimize storm damage. All walls below the 100-year base flood elevation must be built to allow the free rise and flow of storm water, to not cause the accumulation of waterborne debris, and to not become waterborne debris themselves.

Estuarine System AECs--

Estuarine system AECs also bear a direct relationship to hurricane hazard mitigation. Where ocean hazard AECs deal with the dynamics of the oceanfront, estuarine system AECs deal with the problems attending development in or near estuarine lands and waters. North Carolina's extensive estuarine system is a complicated and interdependent system of biological and geological processes, which make it a highly productive and important economic, social, and aesthetic resource for the state and the nation. In addition to being productive, the system is also dynamic--subject to the full complement of water, wave, and wind forces. Therefore, development in or near the estuarine system is subject to erosion and flooding hazards similar to those that accompany oceanfront development. It must be remembered that a large portion of the

damages that North Carolina has sustained from hurricanes and other major storms have been the result of estuarine flooding and erosion, when the storm surge piled into the state's many sounds.

While the primary intent of the CRC's guidelines for development in estuarine system AECs is the preservation of the system's biological productivity, the guidelines also aim "to minimize the likelihood of significant loss of private property and public resources" (N.C. Adm. Code 15:07H.0203). The geological processes and rates of change in the estuarine system are not always as dramatic or as visible as those along the ocean shore, but they are nonetheless important in exposing development to the destructive forces of flooding and erosion. Just as the ocean beaches and dune systems provide protection to landward development, estuarine shorelines and wetlands help buffer development from erosion and absorb floodwaters. Significant alterations to these landforms can weaken the system and put an entire community at risk.

The Coastal Resources Commission has designated four types of AECs within the estuarine system: (1) coastal wetlands, (2) estuarine waters, (3) public trust areas, and (4) estuarine shorelines. The management of estuarine shorelines and coastal wetlands is most relevant to hurricane hazard mitigation.

Estuarine shorelines are "non-ocean shorelines which are especially vulnerable to erosion, flooding, or other adverse effects of wind and water and are intimately connected to the estuary" (N.C. Adm Code 15:07H.0209(b)). The Coastal Resources Commission has designated the estuarine shoreline AEC to encompass the area along the estuaries, bays, sounds, and other brackish waters from the mean high water level to a landward distance of 75 feet. Development within this area can affect the quality of the estuarine environment and is typically exposed to erosion and flooding damages.

Coastal wetlands are defined as "any salt marsh or other marsh subject to regular or occasional flooding by tides, including wind tides" but not hurricane or tropical storm tides (N.C.G.S. 113-229(n)(3)). Coastal marshes supply the nutrients and decayed plant material which support the estuarine system's high productivity levels and complex food chains. "In addition, coastal wetlands serve as the first line of defense in retarding estuarine shoreline erosion. [Wetland] plant stems and leaves tend to dissipate wave action, while the vast network of roots and rhizomes resists soil erosion. In this way, the coastal wetlands serve as barriers against flood damage and control erosion between the estuary and the uplands" (N.C. Adm. Code 15:07H.0205(b)).

The Coastal Resources Commission's use standards for estuarine shorelines require all development projects to substantially preserve natural barriers to erosion. Apart from potential erosion and storm damages, development within the estuarine shoreline AEC must meet a variety of requirements to avoid adverse impacts on the environment due to siltation and other forms of pollution.

The use standards for coastal wetlands, which are the same for estuarine waters and public trust areas, list permitted uses and the requirements they must meet in order to receive a CAMA permit. The standards allow only water-dependent uses to locate in these areas; these uses include docks and moorings, boat ramps, bridges, bulkheads, and navigational channels. Residences, motels, restaurants, private roads, trailer parks, parking lots, and other

activities that are not water-dependent are not permitted. All permitted uses must be constructed to minimize adverse impacts on the productivity and integrity of the wetlands, estuarine waters, and public trust areas. Development projects in estuarine waters must also comply with the standards for ocean hazard AECs. The standards for coastal wetlands, estuarine waters, and public trust areas include specific requirements for the construction of navigational canals and boat basins, drainage ditches, marinas, docks and piers, and bulkheads and shore stabilization measures. None of those requirements directly address storm damages, but they are geared toward maintaining the wetland's integrity and its ability to act as a buffer to flooding and erosion.

Exemptions for Emergency Maintenance and Repairs--

Especially important in regulating post-disaster reconstruction are the Coastal Area Management Act policies governing emergency maintenance and repairs. The language of the Act, as amended, specifically excludes from its definition of development "maintenance or repairs (excluding replacement) necessary to repair damage to structures caused by the elements or to prevent damage to imminently threatened structures by the creation of protective sand dunes" (N.C.G.S. 113A-103(5)b.5). Such actions are thus exempt from the CAMA permit requirement for areas of environmental concern. They include emergency actions taken during or after a hurricane or other major storm to prevent further danger to lives or property or to restore an endangered property to its pre-emergency condition, with no additions or expansions (N.C. Adm. Code 15:7K.0101(5)). However, the exemption is limited. The Coastal Resources Commission has interpreted the Act's definition of development to include any repairs constituting 50 percent or more of the structure's value. Therefore, such repairs must obtain the necessary CAMA permits if they take place in AECs.

The only activity specifically listed as an emergency maintenance action in the current CAMA regulations is beach bulldozing, seaward of the vegetation line, to create a protective sand dike or to obtain materials for any other emergency purpose (N.C. Adm. Code 15:7K.0305(b)). Other activities may qualify as emergency maintenance and repairs under the statutory exemption cited above. The regulations require individuals proposing emergency repairs to consult with the local CAMA permit officer to determine whether the proposed repairs qualify for exemption.

Post-disaster Policies--

In 1981, the Coastal Resources Commission convened a special Post-disaster Task Force to examine ways that state agencies and coastal communities can avoid future storm damages and to formulate policies for meeting this goal. The CRC adopted a set of "post-disaster" policies in the summer of 1982, following the principle that "adequate plans for post-disaster reconstruction should be prepared by and coordinated between all levels of government prior to the advent of a disaster" (N.C. Adm. Code 15:07M.0501).

The policies call for the Coastal Resources Commission to assist the N.C. Department of Crime Control and Public Safety, which is the state's lead agency for disaster preparedness and response. To carry this out, the CRC is

to (1) establish streamlined permit procedures for post-disaster reconstruction, (2) provide staff support as requested for damage assessment and other activities, and (3) require local governments to include disaster planning in their land use plans.

The policies also establish a set of guidelines for hazard mitigation planning which cover both current development and post-disaster reconstruction. Under these policies, the CRC is to advise the North Carolina Building Code Council and the Federal Insurance Administration regarding development standards in coastal hazard areas. The CRC is to advise the Department of Transportation and all public utilities regarding its policies governing the replacement of roads, bridges, water lines, sewer lines, and other utilities in hazardous areas. The policies require all repairs and reconstruction of private and public structures to be done in a safe and sound manner. The policies also call for the CRC to establish guidelines for local governments to follow in formulating reconstruction plans and policies covering such things as the relocation of structures, roads, and utilities and the collection of property information to assist in damage assessment.

State Agency Consistency--

Under the Coastal Area Management Act, any state agency policies governing the acquisition, use, and disposition of land in the coastal area are to take account of and be consistent with the CRC's planning guidelines (N.C.G.S. 113A-108). Thus, the actions of any state agency must comply, to the maximum extent possible, with the CRC's policies, guidelines, and standards as well as local CAMA land use plans; this applies to all state regulatory programs, the use of state-owned lands, financial assistance for public facilities, and the siting of major public and private growth-inducing facilities (Office of Coastal Zone Management, 1978, p. 162).

N.C. State Building Code

Building codes set standards for construction materials, design, and procedures in order to protect lives and property. Important in safeguarding the health, safety, and welfare of the public from unsafe construction practices in normal times, building code standards take on crucial importance during natural disasters, such as hurricanes, when extraordinary stresses are imposed on man-made structures. In coastal communities subject to hurricanes, the building code is one of the most important tools for mitigating hazards to life and property during both the development that takes place before the storm and the reconstruction following the storm.

Building codes regulate the construction, alteration, maintenance, repair, and demolition of buildings and structures. They establish minimally acceptable conditions or standards for all phases of building construction, based upon the properties of construction materials, physical and chemical principles, and engineering and architectural criteria. As legal guides for engineers, designers, and contractors, building codes are enforced by local government building inspectors, who check construction plans prior to issuing building permits and periodically inspect construction sites to ensure that approved plans are followed.

The two major types of building codes are performance codes and specification codes. A performance code recommends the objective to be accomplished and allows the designer to select from various materials and techniques to achieve the desired result. A specification code describes in detail the exact materials and methods to be used. In practice, most codes emphasize performance standards but also include certain specifications for materials and design.

North Carolina's State Building Code (Volume I -- General Construction) applies uniformly to the design, construction, location, and installation of all new residential and commercial structures throughout the state. Derived from the Southern Standard Building Code, the North Carolina Code is supervised by the North Carolina's Commissioner of Insurance and enforced by local building inspectors appointed by city and county governments. An eleven-member Building Code Council appointed by the Governor has responsibility for adopting and amending the Code, approving local building regulations which deviate from the Code, hearing and deciding appeals, and recommending statutory changes and administrative practices. The Division of Engineering and Building Codes of the Department of Insurance serves as staff for the Building Code Council.

To be legally effective, any city or county building code must be approved by the Building Code Council. In the interests of standardization, local deviations from the State Building Code are approved only if a local government can present compelling evidence of necessity for the deviation. The North Carolina Supreme Court has consistently ruled that the State Building Code preempts local building code authority on grounds of the supremacy of state laws over local ordinances.

In addition to the State Building Code, the North Carolina Building Code Council has adopted the North Carolina Residential Building Code (Volume I-B), which governs the construction, alteration, repair, and removal of one and two-family dwellings. The Residential Building Code does not apply to apartments or multifamily residences for three or more families. The Residential Building Code's Appendix D -- "Wind Resistive Construction" -- applies to coastal communities and other areas where residences are subject to winds of greater than 75 miles per hour.

Further construction standards have been adopted by the Coastal Resources Commission. CAMA regulations for ocean hazard AECs require that buildings comply with Appendix D, except where more restrictive standards have been set by the CRC. These standards include requirements for piling size and embedment, foundation stability during a 100-year storm, and floor elevation above the 100-year flood height.

Requirements to Reduce Storm Damage --

Buildings in coastal areas subject to hurricanes must be constructed to resist a number of physical hazards and impacts in order to protect life and property. These hurricane impacts include:

1. Storm surge - the increased ocean level due to increased wind velocity and decreased barometric pressure, producing flooding of buildings;

2. Waves - the increased height of wind-generated waves (on top of the storm surge), producing horizontal shock pressure and vertical uplift pressure on buildings and the scouring of soil;

3. Winds - the increased wind forces, both sustained and gusting, producing structural failure or movement of buildings;

4. Coastal erosion - the loss of land along shorelines due to storm surge and wave action, producing overwash, scour, and liquefaction of soils which undermine building foundations; and

5. Debris battering - the floating and wind-borne objects which strike buildings and produce concentrated battering loads against buildings.

Fire is an additional hazard that can result from, or be magnified by, high wind conditions and structural failures during a hurricane. Fire hazards in wood frame structures, especially multi-story, multi-family modular wood frame buildings, are an increasing potential danger in hurricane-prone coastal communities (Sheaffer & Roland, 1981, p. 4).

A recent review of coastal construction standards for Nags Head describes the forces at work on coastal area buildings during severe storms:

> Design considerations for an elevated building in an oceanfront setting require particular attention to the complex forces and conditions at work during a severe storm. It is not sufficient that the elevated foundation merely bear the gravity weight of the building. Live forces act directly on the building tending to lift and overturn it; the greater the height, the greater the tendency to overturn. Lateral forces from the wind and waves strike it from different directions. Wind rising under the building tends to lift it, pulling the pilings out of the ground; pullout forces must be resisted by the friction of the pilings in the soil. Waves will also lift it if the structure is not elevated sufficiently to let them pass under. The wind forces must be transmitted from the roof and walls to the deck, and through the pilings to the ground without overly stressing the pilings, connections, bracing, and other structural members.
>
> The depth of pilings affects the ability of the structure to resist lateral wind and wave forces that act to deflect the building and its foundation from a vertical position. The length of pilings affects their ability to resist overturning and to provide friction with the soil to resist uplift forces. Bracing is needed to give the structure rigidity, and to take some or all of the lift forces off the pilings; it is desirable to transmit the forces through the bracing as close to the supporting soil as possible.

> Considerations must be given to erosion of supporting soil from the base of the foundation, as well as liquefaction of the soil when immersed, both of which cause the foundation to lose its bearing, frictional, lateral, pullout, or other resistance. (Sheaffer and Roland, 1981, p. 19).

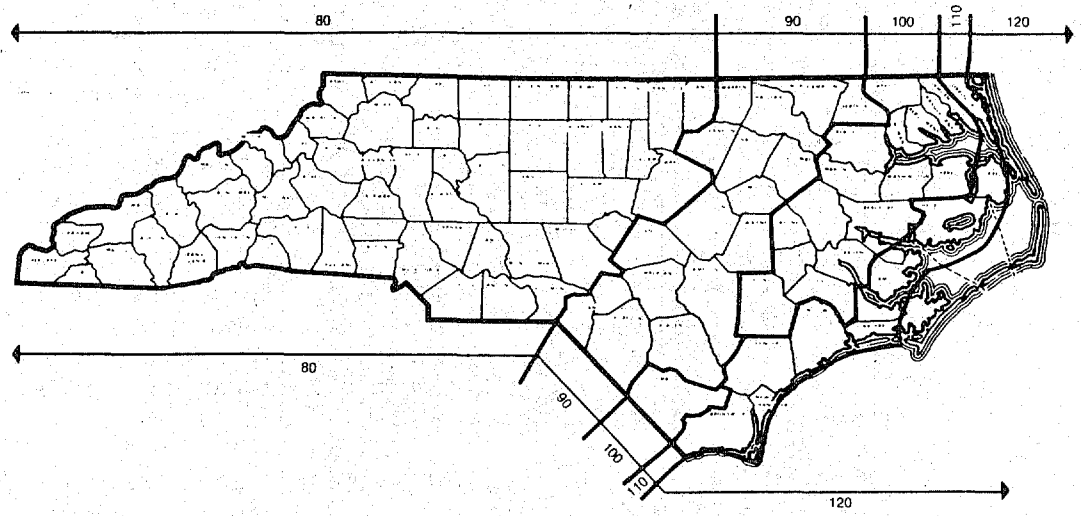
In order to reduce damage from hurricane forces, building codes identify design and construction standards necessary to maintain structural integrity under storm stress. These include:

1. Structural design loads--live and dead--for roofs, floors, walls and foundations under the high wind, wave, water, and battering pressures of the design flood event (the 100-year storm);
2. Design standards, including size, spacing, depth, and bracing for piles, columns, and foundations to resist sliding and overturning due to scour, soil liquefaction, and other forces;
3. Specifications for water resistance of the structure, materials, and fasteners to protect them from deterioration due to exposure to salt spray, groundwater, and submergence;
4. Specifications for anchorage, fasteners, and connections for roofs, walls, joists, beams, pilings, and piers to maintain structural integrity under high wind and water pressures;
5. Tiedown standards for mobile homes to anchor them against hurricane winds; and
6. Build-back and inspection requirements for conforming and nonconforming structures that have been storm-damaged beyond 50 percent.

The North Carolina State Building Code (Volume I) contains standards for minimum design loads under different types of occupancy or use and for different geographic areas of the state which are subject to special loads. Basic design wind velocities are specified in Chapter XII of the Code according to those locations likely to receive winds of a particular velocity, with the highest design velocity (120 miles per hour) specified for the Outer Banks and those parts of Carteret, Onslow, Pender, New Hanover, and Brunswick counties seaward of the Intracoastal Waterway. Design wind velocities are reduced as the location moves inland from the coast (see Figure 4.1). Design of foundations and piles must be based on subsurface investigations at the building site, supervised by a registered engineer or architect (Chapter XIII). Specifications for material strength, quality, fire resistance, connections, and protection against decay are provided for masonry, steel, concrete, and wood construction (Chapters XIV-XVII). Minimum standards are set forth for design of piers, bulkheads, and waterway structures (Chapter XXXIII). The Code requires that reconstruction of any existing buildings damaged in excess of 50 percent of their physical value, as determined by the local building inspection department, must conform to the Code requirements for new buildings.

The North Carolina Uniform Residential Building Code (Volume I-B) contains standards for materials and construction practices for one and two-

Figure 4.1: N.C. State Building Code's Basic Design Wind Velocities (in mph)



Source: N.C. Building Code Council, 1981, Volume I - General Construction, p. 12-18.

family dwellings. Appendix D — "Windstorm Resistive Construction" -- applies to all areas where buildings are subject to winds greater than 75 miles per hour. Appendix D provides standards which must be used for any building erected within 150 feet of the high water mark of the Atlantic Ocean for anchoring and fastening, for roof coverings, and for the type, size, depth, spacing, tying, and bracing of piles. It is related to the design load assumptions of Appendix A -- "Live and Dead Loads" -- which contains procedures for sustaining wind loads of up to 100 miles per hour.

There appears to be a discrepancy between Appendix D, which sets special standards for residential buildings in areas with winds greater than 75 mph, and Section 1205 — "Wind Loads" -- of Volume I of the Code, which establishes a minimum design wind velocity of 80 mph for counties in the western half of North Carolina and minimum velocities of 90 to 120 mph in counties in the eastern half of the state. Appendix D appears to be out of date in terms of its 75 mph wind velocity cut-off level.

The State Building Code Council also maintains the State of North Carolina Regulations for Mobile Homes, which it developed pursuant to the Uniform Standards Code for Mobile Homes Act (N.C.G.S. 143-144 et seq.). These regulations set standards for the sound construction of mobile homes and for inspection and approval of mobile homes at the factory (by Underwriters' Laboratories or a similar agency approved by the Building Code Council). The

regulations also set requirements for anchoring mobile homes to withstand high winds. These "tie-down" requirements vary according to the unit's width, length, and location. They require mobile homes to have both "diagonal" ties (frame to foundation ties) and "vertical" ties (over-the-top ties), both of which must be securely anchored to the ground or foundation. The number of ties required varies throughout the state depending on whether or not the community lies in the state's "hurricane zone." The Building Code Council designated the "hurricane zone" in 1973; it covers 25 counties in eastern North Carolina, including all counties in CAMA's coastal area except Hertford County. Table 4.1 lists the number of diagonal and vertical ties required in the "hurricane zone" for mobile homes of different lengths.

There is wide variety in the hurricane-related design and construction standards contained in building codes adopted by various states. Part of this variation is due to local conditions, but it also may be due to inertia in revising standards to keep up with current knowledge about the actual destructive forces of hurricanes. The North Carolina Building Code Council took a position of national leadership in fostering storm-resistant coastal construction following Hurricane Hazel in 1954, when it instituted piling regulations for elevating the standard oceanfront house at least eight feet off the ground (Sheaffer and Roland, 1981, p.2). In many other states, that elevation requirement was not instituted until the 1970s, when the National Flood Insurance Program became effective. Now, in the 1980s, this aspect of North Carolina's Code would be exceeded by the Federal Emergency Management Agency's new requirement that structures subject to wave action in coastal high hazard areas be elevated not just to the storm surge level but also to the expected wave crest level.

Table 4.1: Tie-down Requirements for Mobile Homes in North Carolina's "Hurricane Zone"

	Unit Length					
	<46'	46'-49'	49'-58'	58'-70'	70'-73'	73'-80'
# diagonal ties per side	4	5	5	6	7	7
# vertical ties per side	2	2	3	3	3	4

Source: Tharrington, personal communication, 08/23/82.

Limitations and Opportunities for Local Government Action to Regulate Construction --

North Carolina's State Building Code may need amendments in order to provide design standards suitable to resist the 100-year storm on the coast of North Carolina. A recent analysis for Nags Head points out that Hurricane Frederic in 1979, which approximates the 100-year storm for North Carolina, destroyed 73 percent of the first tier of oceanfront houses over a 22-mile

stretch of the Alabama coast, where construction standards are similar to those of North Carolina. The analysis (Sheaffer and Roland, 1981) recommends that new coastal construction standards and design criteria for 100-year storm conditions be adopted, with particular attention to (1) wind, waves, flooding, erosion and scour, soils, structural stability, and related conditions, and (2) special fire and structural hazards associated with multi-story, multi-family modular wood frame buildings. Local governments, however, are unable to change the State Building Code in their jurisdictions without approval of the N.C. Building Code Council. The Coastal Resources Commission could represent the collective needs of coastal communities for State Building Code amendments in a request to the Building Code Council to update the standards for hurricane-prone areas.

The local building inspector is the link between code standards and actual construction. Effectiveness of the code and enforcement depends upon the inspector's interpretation of the code, his technical competence, and the adequacy of his time and resources to carry out necessary inspections. Even in normal times, these factors often are limited in coastal communities where part-time inspectors with limited training must try to keep up with surges of development. When demand for enforcement peaks after a hurricane, the adequacy of qualified inspectors can be a crucial factor in whether or not reconstruction is done well or poorly. To assist with this need, a program of special training and certification for coastal building inspectors could be encouraged by the Coastal Resources Commission, along with a procedure for augmenting local code enforcement personnel in post-hurricane periods.

State Regulations Covering Water Supply and Waste Disposal Facilities

In addition to state regulations governing the quality of building construction and development in high hazard coastal areas, there are regulations governing the location and design of public water systems, septic systems, and solid waste facilities to protect them from flood damages.

Water wells and storage systems need to be adequately protected from flooding in order to avoid contamination of drinking water supplies, which is likely to require costly remedies. The N.C. Division of Environmental Management (in DNRCD) maintains well construction standards which require, as a condition to receiving a well construction permit, that a water supply well be located "at a site not generally subject to flooding" (N.C. Adm. Code 15:2C.0007(a)(1)(A)). The N.C. Division of Health Services (in the Department of Human Resources) maintains standards for community water systems to protect them from flooding. The site used for any well that supplies a public water system is not to be subject to flooding (N.C. Adm. Code 10:10D.0803(3)). The covers of ground-level water storage tanks must be located above expected flood levels (N.C. Adm. Code 10:10D.1005(a)(1)). In addition, the construction or modification of a public water system is to avoid locating all or part of a new or expanded facility at a site which is "subject to a significant risk from earthquakes, floods, fires, or other disasters which could cause a breakdown of the public water system or a portion thereof" (N.C. Adm. Code 10:10D.1612(a)(1)).

Protecting septic systems from flooding reduces the risk of the community being without basic sanitary services after a flood. It also reduces the risk that surface waters and groundwater will become contaminated due to septic tank failures. The Division of Health Services regulations for septic tanks with a capacity of less than 3,000 gallons per day stipulate that septic tank systems "shall not be located in areas subject to frequent flooding" (N.C. Adm. Code 10:10.1912(c)(3)). The regulations define these areas as those subject to flooding by the "10-year" flood, or one with a ten-percent probability of occurring in any given year (N.C. Adm. Code 10:10.1903(5)). These rules for septic tanks with a capacity of less than 3,000 gallons per day are administered by local boards of health as part of their permitting procedures. Septic systems with a capacity greater than 3,000 gallons per day are directly regulated by the Division of Environmental Management. Environmental Management's regulations stipulate that such systems "shall not be located in areas subject to frequent flooding" (N.C. Adm. Code 15:2H.0301(f)(5)); as in the case of smaller septic systems, such areas are defined as those subject to the "ten-percent probability" flood.

If solid waste disposal facilities are flooded, significant contamination of surface waters may occur; the community may also be left without an adequate and sanitary place to dispose of its solid waste. In issuing permits for solid waste disposal facilities, the Department of Human Resources requires information on the location of floodplains to accompany all permit applications (N.C. Adm. Code 10:10C.0109(4)). "Floodplains," in this case, include all lands subject to inundation by the "one-percent probability," or "100-year" flood (N.C. Adm. Code 10:10C.0101(4)).

In all the above cases, flood hazard information is used in state-level decisions regarding the location and design of key sanitary facilities. Damages to these facilities from a hurricane or other major storm can create a significant threat to public health. The extent to which flood hazard information is used undoubtedly varies in the above state regulatory decisions; so does the extent to which such information influences final decisions regarding particular facilities. Nonetheless, local officials should remain aware of the role hazard information plays in state decisions regarding water systems, sewer systems, and solid waste facilities in the community.

Several federal programs have a direct bearing on whether or not new development and post-disaster reconstruction in a community are safe from future hurricanes and other coastal storms. The National Flood Insurance Program sets guidelines for developers, homebuilders, and local governments to follow in order to qualify for flood insurance; the program also contains innovative provisions for post-disaster reconstruction which facilitate the relocation of damaged structures out of hazardous areas. The wide range of federal disaster assistance programs are designed to ease the burden of rebuilding after a disaster; the requirements of these programs vary and provide different opportunities for influencing the character of post-disaster reconstruction. Executive Order 11988 -- "Floodplain Management" -- directs federal agencies to avoid encouraging unwise development on flood-prone lands. The Coastal Zone Management Act calls for federal actions to be consistent with the state's coastal management program, which includes state and local hazard mitigation and reconstruction policies.

National Flood Insurance Program

Congress established the National Flood Insurance Program with the National Flood Insurance Act of 1968 (Public Law 90-448) to reduce annual flood losses through more careful planning of flood-prone areas and to provide property owners in those areas with affordable insurance against flood damages.

In the nation's earlier days, measures to reduce flood hazards (such as dikes, levees, seasonal evacuation, and building on stilts) were limited in range and primarily the result of private or local initiatives (AIA Research Corporation, 1981, p. 21). In response to a series of disastrous floods in the 1920s and 1930s, the federal government became directly involved in flood hazard mitigation by launching a massive program (with the Flood Control Act of 1936) of building flood protection works to contain flood waters and improve the drainage capacity of rivers and streams. Also, during the past 40 years, Congress has authorized the Army Corps of Engineers to construct hurricane protection and erosion control works along the nation's coastline in an effort to reduce damages due to coastal storms and natural erosion processes. While carrying out its program for these structural flood control works, the federal government stepped up its provision of relief aid to disaster victims.

Even though the structural flood control projects have yielded significant benefits, annual flood losses have continued to climb. Flood control works often create a false sense of security in a community and development continues into flood-prone areas, often at more intense levels. When flooding exceeds the capacity of structural projects, damages can occur at a larger scale than before the project was built.

In response to ever-increasing annual flood losses and the inability of many citizens to obtain flood coverage from private insurance companies, Congress set up the National Flood Insurance Program. The program, which is administered by the Federal Emergency Management Agency's Federal Insurance

Administration (FIA), offers flood insurance to property owners in designated flood hazard areas. In return, local and state governments enact and enforce comprehensive floodplain management measures to protect lives and properties from future flooding. These floodplain management measures typically involve land use controls and construction standards, as well as other techniques, applied within flood-prone sections of a community. These include all land which would be inundated by the "base flood" or "100-year" flood (that is, the flood which has a one-percent chance of being equalled or exceeded in any given year). The program's main purpose is to reduce the amount of developed property exposed to flooding; it reflects the realization that "non-structural" measures are just as important as "structural" measures in mitigating flood damages.

There are two stages of community participation in the National Flood Insurance Program: the Emergency Phase and the Regular Phase. All of North Carolina's coastal communities are enrolled in either the Regular Phase or the Emergency Phase.

Emergency Program--

A community enters the Emergency Phase after the FIA provides it with a "flood hazard boundary map," which delineates flood hazard areas based on the best available data. Once the community enters the Emergency Phase, property owners can obtain limited insurance coverage for flood losses (up to $35,000 for single-family homes and up to $100,000 for all other structures). Subsidized rates are charged for all structures regardless of their flood risk. The intent of the Emergency Phase is to make coverage available to the community at subsidized rates until a detailed technical study can more accurately delineate flood hazard areas.

To be accepted into the Emergency Phase, the community must have in force preliminary measures for regulating development in designated flood hazard areas. The community must require permits for all proposed construction in the community and must review permits to ensure that development is reasonably safe from flooding. For the flood hazard areas identified by the flood hazard boundary map, the community must require structures to be properly anchored and to use construction materials and methods that will minimize flood damages. New subdivisions must be adequately drained. New or replacement utility systems must be designed and located to prevent flood loss. The Emergency Phase's requirements are minimal and vague; they leave much to the discretion of local government.

Regular Phase --

Once the community is in the Emergency Phase, the Federal Insurance Administration hires an engineering contractor (at no cost to the community) to undertake a detailed study of the community's base flood elevations (BFEs) and flood hazard areas, including the development of a "flood insurance rate map" (FIRM). Based on this study, the FIA derives a schedule of actuarial (non-subsidized) flood insurance rates and the community develops more detailed floodplain management regulations. Once the community adopts these regulations, it enters the Regular Phase, which provides higher levels of

insurance coverage for new and existing residential and non-residential structures. The regulations must protect new construction in designated flood hazard areas from inundation by the 100-year flood (or "base flood).

Flood insurance rate maps for coastal communities divide the 100-year floodplain into two adjacent zones: A-zones and V-zones. The delineation of A-zones and V-zones is based on the best information available on the storm surge levels a community can expect in a 100-year storm. The A-zone contains that area of the 100-year floodplain which is primarily subject to "static" flooding from storm surges (i.e. rising water but little or no wave action). The V-zone, which lies along the shorefront, contains that area of the 100-year floodplain which is subject to wave action as well as the storm surge. The V-zone (also known as the "coastal high hazard flood area") is usually determined by the inland extent of a three-foot breaking wave. It is important to note that while A-zones are mainly subject to static flooding, certain sections of them (adjacent to V-zones) are subject to high velocity water due to the forward momentum of breaking waves (Dames and Moore, Inc., 1981, p. 6). Since A-zones and V-zones involve different types of hazards, they require different types of floodplain management regulations to meet the National Flood Insurance Program's damage reduction requirements.

An important change is currently underway to refine the NFIP's determination of base flood elevations (BFEs) in V-zones. Flood insurance rate maps developed before 1982 geared V-zone BFEs to the water level associated with the 100-year storm surge; this did not account for waves that would appear atop the surge and damage structures elevated only to the storm surge level. The Federal Insurance Administration is now using procedures to calculate 100-year wave crest elevations. These elevations (higher than the 100-year storm surge levels previously used) will become the BFEs for V-zones on all new rate maps and will be used to revise the BFEs appearing on existing rate maps. This adjustment will involve changes in local insurance premium schedules and regulations governing construction in V-zones.

To enroll in the Regular Phase, a community must adopt and administer a set of development regulations that meets the National Flood Insurance Program's minimum requirements. These regulations must be legally enforceable, apply uniformly through the community, and take precedence over any less-restrictive local regulations. They apply in addition to those regulations already adopted under the Emergency Phase. The minimum regulations required in the Regular Phase are listed in Table 4.2. They apply to new construction and substantial improvements to existing structures. "Substantial improvements" cover any repair, reconstruction, or addition whose cost equals or exceeds 50 percent of the structure's market value before the damage has occurred or the improvement is started. The regulations for development in V-zones are more stringent than those for A-zones; V-zones are subject to a higher degree of hazard due to their potential for destructive wave action. Any community may exceed these minimum criteria by adopting more stringent floodplain management regulations; the National Flood Insurance Program encourages this, especially when community officials know of particular hazard conditions that call for higher development standards.

The National Flood Insurance Program also establishes the conditions under which a community may issue variances from its floodplain management regulations. Variances are generally limited to lots of one-half acre or less

Table 4.2: Minimum Requirements for Regular Phase Communities

Flood Hazard Zone	Development Requirement
A-zone (base flood determined)	-Residential structures must be elevated to the base flood level (includes mobile homes outside of existing parks or subdivisions). -Non-residential structures must be elevated or floodproofed to base flood level (registered engineer or architect must certify adequacy of floodproofing methods). -Mobile homes must be elevated to the base flood level in mobile home parks or mobile home subdivisions that are new or have been substantially improved (repair, reconstruction, or expansion exceeding 50 percent of the value of existing streets, utilities, and pads). -Mobile homes must be anchored by over-the-top and frame ties to resist flotation, collapse, and lateral movement. -Evacuation plans for mobile home parks and mobile home subdivisions must be filed with appropriate disaster preparedness authorities. -No new construction or substantial improvement may cause the base flood level to increase by more than one foot at any point in the community. -The community must maintain an accurate and up-to-date record of elevation and floodproofing heights for all new and substantially improved structures.
V-zone	All of the above apply, plus the following: -All structures must be landward of the mean high tide line. -All structures must be elevated to the base flood level on pilings or columns. A registered engineer or architect must certify that anchorages between the pilings and the floor of the structure are adequate to withstand velocity waters and hurricane wave wash. -Fill may not be used for structural support. -The space below the base flood elevation must be free of obstruction or constructed with "breakaway walls." -Mobile homes may only be placed in existing mobile home parks or mobile home subdivisions. -Man-made alterations of sand dunes are prohibited if they will increase potential flood damage.

where existing structures on the surrounding lots are constructed below the base flood level. As the lot size increases beyond one-half acre, the technical justification required for issuing the variance increases. The community shall only issue a variance (1) upon a showing of good and sufficient cause, (2) when failure to issue the variance would lead to exceptional hardship, and (3) when the variance will not increase the threat to public safety or lead to extraordinary public expense.

Relocation of Damaged Structures--

When a structure is damaged by flooding and the property owner holds a flood insurance policy, the Federal Insurance Administration determines the property owner's claim and pays the cost of repairing or rebuilding the structure up to the policy's limits. Until 1980, the National Flood Insurance Program paid claims with little or no provision for relocating the structure out of the flood hazard area. The insurance claim would pay for repairs only to restore the building to its original condition and location; the property owner had to bear any costs beyond this for elevating or relocating the building. Buildings were typically returned to their original condition, still ripe for damage by the next storm. Around 1980, this pattern began to change as the Federal Insurance Administration began emphasizing hazard mitigation as a high priority and instituted two innovative elements as part of its claim procedures: the constructive total loss approach and the Section 1362 relocation program.

The constructive total loss approach covers those cases where a property is not totally destroyed but has lost its economic value. It requires the full cooperation of the property owner and the local government involved. The approach is used where the local government takes such action as prohibiting damaged structures to be rebuilt in areas with a high likelihood of future flooding. This allows the FIA to declare the property a "constructive total loss" and pay the owner's claim up to the policy limits even though the actual damages do not equal the total covered by the policy. The owner can then use the money to rebuild on a site outside the flood hazard area. Ownership of the damaged property is then dedicated to the community for open space use. The Federal Insurance Administrator is responsible for deciding to use the approach in any given situation. The "constructive total loss" approach is only used in special situations where damages are particularly severe and the property owner and local government agree to participate. To date, its use has been limited, but the approach has proven successful.

The FIA first used the "constructive total loss" approach in 1979 in Conroe, Texas, to relocate approximately 50 flood-damaged structures. Thirty-five of these had been flooded every year since 1972; their owners had repeatedly received federal disaster loans and insurance payments. To relocate the homes, the FIA made available to each owner payments of up to $35,000. Low-interest loans from the Small Business Adninistration also helped cover the costs of relocation. (Ralph M. Fields Associates, 1981, p. 75).

A variation of the "constructive total loss" approach was recently used in Nags Head, North Carolina, to relocate approximately 14 oceanfront homes

which faced imminent collapse due to storm-induced erosion. Several ocean-front homes in South Nags Head were damaged by a storm to a point where the next major storm was certain to erode the land beneath them and cause them to collapse. The FIA could have simply paid the claims to repair the buildings to their original condition in their original locations. However, the FIA realized that this would result in another claims payment after the next storm and sought a more far-sighted solution. The FIA, in cooperation with the homeowners and local government, settled the claims to pay for moving the damaged homes back from the rapidly eroding shoreline, yet still on the owner's lots, and out of the area posing the greatest hazard in future storms. The decision saved the FIA about $775,000 in future claims (Pasterick 1980, p. 15).

Section 1362 of the National Flood Insurance Act empowers the FIA to purchase insured properties that have been seriously damaged by flooding, to move the damaged structures, and to transfer the land as open space to a state or local government agency. As with the "constructive total loss" approach, the Section 1362 program relies on the full cooperation of the property owner and the local government. In order to qualify for purchase under Section 1362, the damaged property must be covered by a flood insurance policy and must meet one or more of the following criteria:

1. damaged by flooding "substantially beyond repair";

2. damaged by flooding no less than three times in the past five years, where the average cost of repairs was no less than 25 percent of the value of the structure; and

3. damaged to an extent where an existing statute, ordinance, or regulation prevents its restoration or allows its restoration only at a significantly higher cost.

The property owner can use the money from the sale to rebuild at another location outside the flood hazard area. Structures which meet the above criteria must also show an economic benefit to be gained through acquisition of the property (such as avoiding future damage and reducing flood insurance claim payments and disaster relief costs).

The FIA also maintains eight "community selection factors" for allocating Section 1362 funds (see Table 4.3). A community does not need to meet all the factors. Some of the factors carry more weight than others when the FIA is evaluating the community for participation in the program. A community's ability to rank highly on these criteria is an important factor in obtaining funding, especially since overall funding for the program has been limited. Congress did not appropriate money to administer Section 1362 until 1980, when it allocated 5.4 million dollars for Fiscal Year 1980. Subsequent appropriations have been as follows: FY81 — five million dollars; FY 82 — 1.6 million dollars; and FY 83 — 4.8 million dollars (projected). The community seeking Section 1362 funds must also submit a "re-use plan" outlining how the community will manage the acquired land and indicating any changes it expects to make in existing land use plans and ordinances to accommodate the uses it proposes for the acquired properties.

Table 4.3: Community Selection Factors for the Section 1362 Program

1. The permanent removal of flood-prone structures will contribute to existing, on-going programs for permanent evacuation of flood plains.

2. In addition to hazard mitigation, acquisition will contribute to the achievement of multiple community development goals (such as environmental protection, open space/recreation, urban renewal, or some other public purpose).

3. The acquisition and relocation of flood-prone structures will have an economic benefit in terms of eliminating future flood insurance claims, avoiding future damage, reducing future disaster relief costs, avoiding business interruption, and reducing loss of life.

4. The distribution of properties to be acquired under Section 1362 (or the distribution of these properties combined with properties that can be acquired through other programs) will result in a logical, usable, and desirable land use pattern.

5. Alternatives to acquisition under Section 1362 have been investigated and found to be less effective than Section 1362 in meeting the community's floodplain management and hazard mitigation goals. These alternatives could include, but are not limited to, floodproofing, structural flood protection, or acquisition and relocation programs of local, state, or other federal agencies.

6. The community has undergone a planning process and found acquisition/relocation to be the most desirable alternative in terms of cost, degree of flood protection achieved, environmental enhancement, and other factors.

7. The community has demonstrated, or agreed to pursue, an active program of sound floodplain management which exceeds the minimum requirements of the National Flood Insurance Program.

8. The community can actively participate in the planning and implementation of the Section 1362 program through the provision of either financial or staff resources.

The Section 1362 program has been used more widely than the "constructive total loss" approach. After the devastation of Hurricane Frederic in 1979, the FIA used about one million dollars in Section 1362 funds to acquire five damaged beach properties in Gulf Shores, Alabama. The FIA then conveyed title to the town and added 3.5 acres to the public beach. In 1980, the FIA used $500,000 in Section 1362 funds to purchase 16 beachfront lots in Scituate, Massachusetts, which were severely damaged in 1978 by the most destructive northeaster to ever hit the Massachusetts coast. The lots are now managed by the town as recreational beach and conservation areas. (Ralph M. Shields Associates, 1981, p. 74).

Since the Section 1362 program has dealt mainly with scattered damaged structures in those communities where it has been used, local governments have often used other sources (such as the disaster relief programs described in the next section) to supplement Section 1362 funds in relocating damaged buildings. Advance planning before a major storm occurs can help the community target its efforts and effectively pursue sources of funding for post-disaster relocation projects. Such planning should account for the hazardous areas present in the community, local reconstruction policies, and the different sources of funding available.

Federal Disaster Assistance Programs

The federal government administers over 100 different programs which provide disaster assistance to individuals, businesses, and state and local governments (see FEMA's Digest of Federal Disaster Assistance Programs). Many of these programs are only used in a community following a Presidential disaster declaration. The others are not geared specifically to major disasters but can play a role in hazard mitigation planning and post-disaster recovery. The scope of these programs is broad, designed to meet the many and varied needs of a disaster-stricken community. Some programs assist emergency operations and the immediate needs of people in the community (such as search and rescue, emergency communications, temporary shelter, and health services). Some programs assist the reconstruction activities following a disaster (such as debris removal and financing the repair of damaged structures and utilities). Some programs assist local and state agencies in planning to mitigate the effects of future disasters.

Since the focus of this report is on managing development, the following discussion of federal disaster assistance programs will focus on those programs which influence the location and quality of reconstruction in the community. The discussion opens with a brief description of the main federal programs assisting reconstruction. It then follows with a description of how these programs are coordinated after a flood or major coastal storm to ensure that federal assistance leaves the community safer from damage than it was before the disaster hit.

Assistance for Repairs and Reconstruction --

Table 4.4 presents the primary federal programs which help finance post-disaster repairs and reconstruction. Most of these programs require a Presidential disaster declaration before they can be used in a community. The programs provide grants, loans, and insurance claims to aid individuals, businesses, and government agencies in the repair, reconstruction, or replacement of private homes, commercial establishments, and public facilities. The types of assistance available and the eligibility requirements of each program are described below.

Assistance available to individuals --

Flood Insurance — Any property owner who holds a flood insurance policy with the Federal Insurance Administration (part of FEMA) and whose property is damaged by flooding can settle his claim with the FIA to defray the costs of repairing, reconstructing, or relocating the damaged structure.

Individual and Family Grants — This program provides individuals and families with grants of up to $5,000 to meet necessary disaster-related expenses which cannot be met through assistance from other sources. The program is administered by the N.C. Division of Emergency Management, with FEMA providing 75 percent of the funding.

Home/Personal Property Disaster Loans -- The Small Business Administration offers these loans to homeowners to help repair or replace property that is damaged by a natural disaster. Coverage for real property is limited to $50,000 coverage for personal property is limited to $10,000. If the property is covered by insurance, the SBA will only fund the difference between the total amount of damages and the insurance proceeds received by the property owner.

Temporary Housing -- For individuals and families displaced by a disaster, FEMA offers temporary housing in government, private, or commercial structures and grants for repairs to owner-occupied damaged structures. No rental fees are charged for the first 12 months of occupancy. The program also provides temporary assistance with mortgage and rent payments for persons facing financial hardship as a result of a disaster.

Mobile Home Loans Insurance and Mortgage Insurance - Homes for Disaster Victims -- The Department of Housing and Urban Development can guarantee or insure loans to disaster victims for purchasing homes.

Adjustments to Federal Loans — HUD can refinance any loan it has made when a property owner holding a HUD loan needs refinancing because of damage to his property caused by a natural disaster.

Assistance available to businesses and private institutions --

Flood Insurance -- (described above)

Table 4.4: Federal Disaster Assistance Programs Aiding Directly in Repairs and Reconstruction

Program	OMB Catalog No.*	Funding Agency	Available to . . .			Presidential Declaration Required
			Individual	Business	Government	
Flood Insurance	83.100	FEMA	X	X		
Individual & Family Grants	83.300	FEMA	X			X
Home/Personal Property Disaster Loans	59.008	SBA	X			X
Temporary Housing	83.300	FEMA	X			X
Mobile Home Loans Insurance	14.110	HUD	X			X
Mortgage Insurance--Homes for Disaster Victims	14.119	HUD	X			X
Adjustments to Federal Loans	83.300	Vet. Adm.	X			X
Physical Disaster Loans to Businesses	59.008	SBA		X		X
Aid to Major Sources of Employment	83.300	SBA/FmHA		X		X
Economic Injury Disaster Loans	59.002	SBA		X		X
Repair and Restoration of Private Non-profit Facilities	83.300	FEMA		X		X
Rural Electrification Loans and Loan Guarantees	10.805	REA(USDA)		X	X	X
Rural Telephone Loans and Loan Guarantees	10.851	REA(USDA)		X		X
Repair and Restoration of Public Facilities	83.300	FEMA			X	X
CDBG Secretary's Fund for Disaster Assistance	14.218	HUD			X	X
Federal-aid Highway Repair	?	FHWA(DOT)			X	
Debris Removal	83.300	FEMA**	X	X	X	X

*Refer to the Office of Management and Budget's Catalog of Federal Domestic Assistance.

**FEMA makes requests for debris removal to the appropriate federal agencies.

Physical Disaster Loans -- Under this program, the Small Business Administration can make loans of up to $500,000 to businesses and private non-profit institutions to repair or replace real property, equipment, inventory, and other assets to their pre-disaster condition. Any insurance proceeds must be deducted from the total amount of damages to determine the amount an applicant may borrow from the SBA. These loans are limited to 85 percent of the total verified damage.

Aid to Major Sources of Employment — The Small Business Administration offers long-term, low-interest loans to a non-agricultural enterprise that constitutes a major source of employment in the community and is no longer in substantial operation due to the disaster. The program aims to help major employers resume operations and to help restore the economic viability of the community. The Farmers Home Administration conducts the program for agricultural concerns.

Economic Injury Disaster Loans -- These SBA loans are available only to small businesses that have suffered substantial financial injury--with or without actual physical damage--as a result of a disaster. The loans provide up to $500,000 to help the business maintain its working capital position during the disaster period and meet financial obligations which it could have met if the disaster had not occurred.

Repair or Restoration of Private Non-profit Facilities — FEMA provides grants to cover up to 100 percent of the net cost of repairing, reconstructing, or replacing damaged non-profit facilities to their pre-disaster condition and in conformity with existing codes and standards. Private non-profit facilities include schools, utilities, and medical facilities.

Rural Electrification Loans and Loan Guarantees and Rural Telephone Loans and Loan Guarantees — The Department of Agriculture's Rural Electrification Administration offers guaranteed/insured loans to electric and telephone companies who have suffered economic hardship or property damage as a result of a natural disaster.

Assistance Available to Local and State Agencies --

Repair or Restoration of Public Facilities — FEMA will provide grants to local and state agencies to help defray the cost of repairing, reconstructing, or replacing damaged public facilities. "Public facilities" include public utilities, buildings, recreational facilities, non-federal-aid streets, and flood control projects.

CDBG Secretary's Fund for Disaster Assistance — When funds from other sources are not available, the Department of Housing and Urban Development, at the discretion of its Secretary, provides block grants to disaster-stricken communities. The grants are intended to meet the community's development needs following a disaster to restore or maintain the community's safety and economic stability.

Federal-Aid Highway Repair -- The Federal Highway Administration provides project grants to state highway agencies, after a declaration of emergency by the Governor, for repairing or reconstructing federal-aid roads and trails which have suffered serious damage in a natural disaster.

Debris Removal -- FEMA can issue grants to state and local governments to pay for removing debris and wreckage from public and private lands and waters. FEMA can also arrange for appropriate federal agencies (such as the Coast Guard or Corps of Engineers) to perform the work directly. Individuals, businesses, and government agencies are all eligible for assistance.

Most of the programs just described require a Presidential disaster declaration before they may be used in the community. The President will declare a "major disaster" only at the request of the Governor and only when the situation is of such severity and magnitude that it is beyond the capabilities of the local and state governments involved. Immediately after the Presidential declaration, FEMA's Associate Director for Disaster Response and Recovery, based on the Governor's request, designates those communities that are eligible for federal disaster assistance and appoints FEMA's Regional Director (or another federal official) as the disaster area's Federal Coordinating Officer (FCO). The FCO, with the assistance of disaster specialists from the various federal agencies involved, coordinates all federal activities with each other and with state, local, and private response efforts. He also coordinates all federal assistance programs and helps local citizens and public officials obtain the assistance for which they are eligible. At the same time, the Governor puts the state's disaster response program in motion and appoints a State Coordinating Officer (from the N.C. Division of Emergency Management) as the primary liaison between the state and federal and local officials. The Governor and FEMA's Regional Director then execute a Federal-State Disaster Assistance Agreement which outlines the terms by which federal aid becomes available.

The Federal Coordinating Officer, usually in conjunction with the State Coordinating Officer, sets up a Disaster Field Office within the stricken area which is staffed by representatives of the various federal and state agencies responsible for providing disaster assistance. In addition to the Disaster Field Office, FEMA will set up one or more Disaster Assistance Centers where representatives of federal, state, and local agencies and private relief organizations can counsel disaster victims and help them apply for disaster assistance. Information about the types of aid available is broadcast by radio, television, newspaper, and pamphlets. FEMA may also send out mobile teams to assist persons in areas lacking access to a Disaster Assistance Center.

FEMA representatives also brief local and state officials regarding the types of assistance available to them and the procedures for obtaining disaster relief funds. After this briefing, federal personnel prepare Damage Survey Reports which document disaster damages, estimate repair costs, and recommend the scope of work to receive federal assistance. Federal personnel also help eligible local and state agencies file applications for relief aid, which are submitted for approval through the state's Division of Emergency Management to the FEMA Regional Director (or other appropriate agency head).

Due to the variety of needs facing a disaster-stricken community and the variety of disaster relief programs administered by different federal agencies, coordination appears to be the most difficult task during the period following a hurricane, flood, or other natural disaster. The creation of the Federal Emergency Management Agency in 1978 improved the coordination of federal efforts by assigning one agency lead responsibility and by bringing into one agency several programs that were previously administered by different agencies. Nonetheless, responsibility for administering disaster relief programs is still dispersed.

Until 1980, there was little coordination between agencies to provide disaster assistance in such a way as to reduce the threat of future damages in the community by influencing the quality and location of reconstruction. Since 1980, Interagency Regional Hazard Mitigation Teams have been assembled to better coordinate federal response to the needs of a disaster-stricken community, to avoid duplication in federal relief efforts, and to help the community identify opportunities for mitigating future losses through land use controls, relocation, public acquisition, floodproofing, and other means.

Interagency Regional Hazard Mitigation Teams --

In December 1980, the primary federal agencies which provide construction funds and disaster relief aid signed an "Interagency Agreement on Non-structural Damage Reduction Measures as Applied to Common Flood Disaster Planning and Post-Flood Recovery Practices." The agreement addresses flood damage reduction, pre-disaster planning, and post-disaster recovery activities. Twelve agencies sat on a special interagency task force and signed the agreement: the Federal Emergency Management Agency (FEMA), the Environmental Protection Agency (EPA), the Small Business Administration (SBA), the Tennessee Valley Authority (TVA), and the Departments of Agriculture, Commerce, Defense (Army), Education, Health and Human Services, Housing and Urban Development, Interior, and Transportation. The agreement states, as a common policy, that post-disaster relief activities should prevent future losses and help disaster victims relocate out of high hazard areas rather than rebuild the community to its prior, more vulnerable state. The agreement also encourages pre-disaster planning to reduce future losses, with special attention to floodproofing actions and "non-structural" measures (such as development guidelines and relocation). The Interagency Agreement is based on four guiding concepts:

1. The importance of non-structural approaches to reducing damages from flood and other hazards;

2. The value and necessity of planning ahead for actions to reduce future damages--both before and after disaster strikes;

3. The special opportunities offered by the period immediately following a disaster for reducing future damages from floods and other natural disasters; and

4. Realization that many federal expenditures, particularly expenditures for disaster relief, have been used simply to restore conditions that existed before disaster struck. The recipients of these funds remain subject to flood hazards, and it is only a matter of time until disaster strikes again and the entire process is repeated. (FEMA, 1981, p. I-2).

The Interagency Agreement establishes Hazard Mitigation Teams for each of the ten federal regions to recommend specific mitigation measures in disaster-stricken communities. The teams consist of representatives from each agency which signed the agreement. The FEMA Regional Director mobilizes the region's team in response to a Presidential declaration of disaster or emergency; the team is then joined by representatives of the affected state and local governments. As part of the community recovery effort, the team conducts an on-site analysis of the extent and severity of damage, identifies mitigation opportunities, and completes a Hazard Mitigation Report within 15 days of the Presidential declaration. The report recommends detailed mitigation measures and outlines how the disaster assistance available from each agency should be coordinated to carry them out. By issuing a report so soon after the disaster, federal agency representatives have more specific guidance in deciding how to allocate disaster relief funds and technical assistance before long-term recovery decisions are made. The team issues a follow-up report 90 days after the initial report to assess whether or not the agencies have followed the prescribed mitigation program. The Hazard Mitigation Team's role is advisory; its recommendations are not binding. The team's Hazard Mitigation Report complements the long-term Hazard Mitigation Plan required by Section 406 of the Federal Disaster Relief Act of 1974 (P.L. 93-288). Figure 7.7 illustrates the relative timing of federal disaster assistance efforts.

One advantage of the Interagency Regional Hazard Mitigation Team is that it provides a good forum for combining different disaster assistance programs into one package to address a specific need or mitigation opportunity in the community. This allows innovation where a single program acting alone might preclude a constructive and effective long-term response to a particular hazard. In May 1981, after a flood in Mobile, Alabama, the Interagency Team recommended the relocation of 50 to 70 dwelling units out of the flood plain. To follow through on this recommendation, the Interagency Team brought together an assistance package providing acquisition and relocation funds from different FEMA, HUD, and Corps of Engineers programs.

The Section 406 Hazard Mitigation Plan --

Section 406 of the Federal Disaster Relief Act requires state and local governments receiving federal disaster assistance to evaluate natural hazards in the disaster area and to take appropriate action to mitigate them. To carry out Section 406, FEMA has developed Hazard Mitigation Regulations (44 CFR 205, Subpart M); these regulations outline a process for federal, state, and local cooperation in evaluating hazards in the community and in selecting reasonable and effective measures to mitigate the effects of future disasters. The process culminates in the development of a Hazard Mitigation Plan, which the state submits to FEMA's Regional Director 180 days after the Presidential declaration.

The Section 406 Hazard Mitigation Plan has three primary goals:

1. To follow-up, in detail, recommendations of the federal/state/local survey and planning teams and the Interagency Regional Hazard Mitigation Team;

2. To establish both immediate and long-term planning frameworks for implementation of hazard mitigation efforts;

3. To recommend hazard mitigation alternatives for local, state and federal agencies.
(FEMA, 1981, p. C-6).

In meeting these goals, FEMA relies on the Federal-State Disaster Assistance Agreement, a joint federal/state/local survey team, and a joint federal/state/local planning team.

Under the Section 406 regulations, FEMA's Regional Director must include hazard mitigation in the Federal-State Disaster Assistance Agreement as a condition to state and local governments receiving relief funds. The state typically agrees (1) to evaluate natural hazards in the disaster area (or have the local governments applying for aid do so), (2) to follow up with applicants to ensure that they take appropriate actions to mitigate the hazards, (3) to review and update portions of emergency plans dealing with mitigation, and (4) to prepare and submit a Hazard Mitigation Plan for the disaster area.

The joint federal/state/local survey team is composed of federal, state, and local Hazard Mitigation Coordinators which are appointed by the FEMA Regional Director, the Governor's Authorized Representative, and the local government applying for aid. The survey team uses information from site visits, Damage Survey Reports, and the Interagency Hazard Mitigation Report to identify significant hazards and their impacts and to evaluate and recommend specific hazard mitigation measures. The survey team submits its recommendations to the FEMA Regional Director and the Governor's Authorized Representative.

The joint federal/state/local planning team is set up in the same manner as the survey team, often with the same persons sitting on both. The planning team evaluates state and local hazard mitigation plans and programs to see if they are effective at avoiding future disasters. Based on this evaluation, and the survey team's findings, the planning team prepares the Section 406 Hazard Mitigation Plan, which the Governor's Authorized Representative submits to the FEMA Regional Director. The Regional Director can then require the local or state government to update or develop appropriate hazard mitigation measures.

Under the Section 406 regulations, FEMA can approve or prescribe various hazard mitigation measures as a condition for issuing federal disaster aid. These measures include land use regulations, construction standards, and other methods of avoiding the hazard. Land use regulations may include requiring facilities to locate outside of high hazard areas as well as other steps to protect individual facilities and to discourage development in high hazard areas. Construction standards will include those of the National Flood Insurance Program as well as state and local standards which the joint survey and

planning teams might recommend. The FEMA Regional Director can deny funding for the repair or reconstruction of a building in a high hazard area where the structure would be subject to repeated damage or where a practical alternative location exists outside the high hazard area.

Executive Order 11988 -- Floodplain Management

President Carter issued Executive Order 11988 -- "Floodplain Management" -- in 1977 as an initiative for coordinating federal policies to protect lives and property and to preserve and restore the natural values of flood-prone lands. The order directs federal agencies to lead the nation by demonstrating a comprehensive approach to floodplain management and to prepare administrative procedures that achieve the order's goals. The order's primary objective is:

> to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative (U.S. Water Resources Council, 1978, p. 2).

The order is broad-ranging; it applies to all actions conducted, supported, and permitted by the federal government. For each action, the responsible federal agency must:

1. determine if the action is in or affects the base floodplain (at a minimum, the area subject to inundation by the one-percent or 100-year flood);

2. avoid the base floodplain unless it is the only practicable alternative;

3. if the base floodplain cannot be avoided, adjust the action to minimize hazards to life and property and to minimize impacts on the natural environment; and

4. notify the public about possible federal actions in the base floodplain.

The order also requires federal agencies to amend or issue regulations and procedures to carry out these four directives.

As part of its long-term effort to establish a unified national program for floodplain management, the U.S. Water Resources Council issued Floodplain Management Guidelines for Implementing E.O. 11988 in 1978. The guidelines are designed to assist federal agencies in the preparation and implementation of procedures to carry out the order. The guidelines are intended to create a consistent federal policy discouraging floodplain development even though it does not in all cases prohibit federal or federally-assisted floodplain development. Like the National Flood Insurance Program's minimum development regulations the guidelines seek to break the cycle of flooding-disaster relief-flooding-disaster relief by which development continues in flood-prone

areas only to be bailed out by federal assistance when damages occur. By minimizing federal involvement in floodplain development, E.O. 11988 and its guidelines seek to reduce the risk of flood damages.

The guidelines set up an eight-step decision-making process that federal agencies can use to comply with the order. The process and its individual steps can be adapted to meet the particular needs of an individual agency or in response to a particular problem. The eight steps of the process are as follows:

1. determine if a proposed action is located in the base floodplain;

2. early public review of the proposed action;

3. identify and evaluate practicable alternatives to locating in the base floodplain;

4. identify impacts of the proposed action;

5. minimize the impacts, or restore and preserve the base floodplain;

6. reevaluate alternatives;

7. issue findings and public explanation of the decision; and

8. implement the action.

The steps follow the pattern illustrated in Figure 4.2. The decision-making process is also designed to satisfy the requirements of Executive Order 11990 -- "Protection of Wetlands" -- which calls for federal actions to have minimal impacts on the nation's wetlands, most of which fall in riverine and coastal floodplains. However, the only action E.O. 11990 covers is new construction.

The impact of E.O. 11988 and the Water Resources Council's floodplain management guidelines on federal agency procedures has been, understandably, quite broad. The order and guidelines apply to all federal actions to:

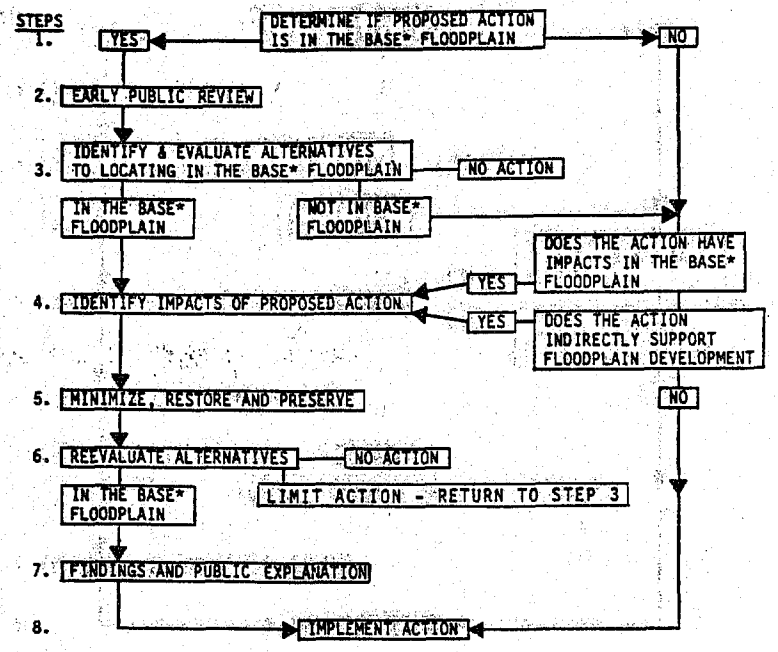
1. acquire, manage, or dispose of federal lands and facilities;

2. undertake, finance, or assist construction and improvements; and

3. conduct activities and programs affecting land use, including planning, regulating, and licensing (U.S. Water Resources Council, 1978, p. 2).

Responsibility for applying the guidelines rests with individual federal agencies which have adopted procedures to guide their own actions as they occur in or affect the nation's floodplains.

Figure 4.2: Decision-making Process for E.O. 11988



*For critical actions, substitute "500-Year" for "base." A "critical action" is one for which even a slight chance of flooding is too great. Critical facilities include hospitals, power plants, storage for essential or irreplaceable records, and facilities containing volatile, toxic, flammable, or water-reactive materials.

Source: U.S. Water Resources Council, 1978, p. 20.

The procedures adopted by the Federal Emergency Management Agency to carry out E.O. 11988 should help illustrate how the order influences agency actions and should provide some insight into how the order influences hazard mitigation and post-disaster reconstruction. FEMA issued its final regulations for implementing E.O. 11988 on September 9, 1980 (45 F.R. 59520-59537); these are tailored to FEMA's actions and are more detailed than the Water Resources Council's guidelines. They deal mainly with FEMA's disaster assistance program, though some provisions cover the National Flood Insurance Program and place restrictions on the availability of flood insurance. Not all FEMA actions are subject to the regulations, only those which affect floodplains or present a hazard by locating in the floodplain.

In accordance with the terms of E.O. 11988, FEMA has exempted certain actions from the regulations, such as emergency work essential to save lives and to protect property and public health and safety. FEMA has also exempted

a category of minor actions offering no potential for floodplain management, such as assistance of up to $3,750 for home repairs and assistance of up to $5,000 for repairs to public facilities. (The exemption for repairs to a public facility does not apply if the facility is located in a coastal high hazard area -- i.e., a V-zone -- or constitutes new construction or a substantial improvement.)

FEMA's regulations essentially follow the Water Resources Council's eight-step decision-making process. In determining if the proposed action is in the base floodplain (Step 1), FEMA relies on the flood insurance rate maps (FIRMs) and flood hazard boundary maps (FHBMs) prepared by the Federal Insurance Administration to provide information on floodplain boundaries, base flood elevations, and the locations of floodways and coastal high hazard areas. The more costly the action or the greater the damage potential it creates, the more information FEMA requires to make its decision.

In providing early public notice of a proposed action (Step 2), FEMA bases its decision regarding the type and timing of public notice on the scale of the action, its anticipated impacts, the degree of public need for the action, the number of affected agencies and individuals, and the potential for controversy. Larger actions and ones with broader impacts require something more than a legal notice in the local newspaper, and may even involve a public hearing and direct notice to affected individuals.

In determining whether the base floodplain is the only practicable location (Step 3), FEMA considers alternative sites outside the floodplain, alternative actions with less impact on the floodplain, and the "no action" alternative. If an alternative site or action appears practicable, FEMA will conduct a more thorough evaluation of the proposed action and alternatives. If this preliminary determination selects an action in the floodplain, FEMA gathers additional information (Steps 4 and 5) to determine if the proposed action is the only practicable alternative. "Practicable" is a somewhat loose term, which includes an evaluation of existing natural constraints, social and economic concerns, and legal restrictions; the need to locate in the floodplain must clearly outweigh the need to minimize flood hazards and impacts on the natural environment.

In identifying the impacts of the proposed action (Step 4), FEMA collects more information for larger project and for projects with a greater potential for flood damages or impacts on the natural environment. The amount and detail of information collected will depend on what information is necessary to avoid development in the floodplain or to minimize its impacts. The types of impacts identified include those on lives, property, public health and safety, and the natural environment; this may include collecting more information on flood depth, water velocities, flooding duration, warning times, and evacuation routes. FEMA must also look at the impacts that the proposed action could have on other properties in the floodplain, such as increasing flood heights, stimulating erosion, and causing debris problems.

In modifying the proposed action to minimize hazards and adverse impacts in the floodplain and to restore or preserve the floodplain's natural values (Step 5), FEMA balances the need to locate in the floodplain against several "minimization factors." These factors include reducing, to the extent feasible, (1) the risk of harm to lives and property from the 100-year flood,

(2) potential adverse impacts the action may have on others, and (3) potential adverse impacts on the floodplain's natural values. In addition to the general requirement to reduce the above impacts, FEMA must meet specific self-imposed requirements governing development in flood hazard areas (such as the FIA's elevation and floodproofing requirements and regulations for development in V-zones).

In reevaluating the alternatives (Step 6), FEMA must determine whether the proposed action is still practicable in the floodplain location in light of its evaluation of alternative sites and actions and its assessment of the proposed action's impacts. If hazards and other impacts cannot be minimized within the floodplain, the practicability of the proposed action is highly questionable. In determining that the proposed action is the best alternative, FEMA must again demonstrate that the benefits of locating in the floodplain clearly outweigh the hazards and impacts it creates. The hazards and impacts may be reduced by incorporating into the proposed action the "minimization" techniques identified in Step 5.

If FEMA decides to carry out an action in or affecting the floodplain, it must notify the public of its final decision (Step 7). This notice must include an explanation of the factors that were considered in making the decision. In carrying out the action (Step 8), FEMA must review its progress to ensure that it meets its goals and incorporates appropriate features to minimize hazards and impacts.

As with FEMA, other federal agencies must follow similar procedures to comply with E.O. 11988 in undertaking activities in floodplains. These procedures apply both to new construction and to reconstruction following a hurricane, flood, or similar disaster. The procedures adopted pursuant to E.O. 11988 have imposed a new set of requirements for new development and reconstruction to follow and, possibly, created some delays in permitting such. However, the procedures have also made the actions of federal agencies more consistent by providing a common set of standards and guidelines for all to follow. They also provide a means of ensuring that the risk of flood damages is minimized to the extent possible for any activities undertaken or assisted by the federal government.

Barrier Islands Legislation

Recognizing the significant subsidies that the federal government provides to development on barrier islands, while at the same time trying to mitigate coastal hazards and promote the protection of fragile coastal ecosystems, a movement has risen in Congress since 1980 to limit federal involvement in barrier island development. The philosophy guiding this movement is that the federal government should decrease its subsidization of barrier island development (through the National Flood Insurance Program, federal disaster assistance programs, construction aid programs, etc.) and transfer the financial risks associated with building on barrier islands -- a rather hazardous environment -- to the private sector. This is an attempt to break the recurring cycle of federal subsidies for barrier island development followed by federal subsidies for post-disaster repairs and reconstruction.

While it recognizes that the federal government should not determine what private owners can do with their property, it also recognizes that the nation's taxpayers should not be subsidizing the recurring costs and high risks of private investment on coastal barriers (U.S. Department of the Interior, 1982, p. 15). Since the North Carolina coastline is predominated by barrier islands, recent Congressional actions regarding barrier islands can have a definite impact on how well new development and post-disaster reconstruction in North Carolina are protected against hurricane damages.

In April of 1981, two bills (H.R.3252 and S.1018) were introduced in Congress that would prohibit nearly all federal expenditures and financial assistance on undeveloped coastal barriers. These two bills, proposed as the "Coastal Barrier Resources Act," attempt to reconcile federal development programs with federal environmental protection and hazard reduction programs to provide a consistent federal policy regarding undeveloped coastal barriers.

As an outgrowth of this movement, Congress has enacted a prohibition on federal flood insurance coverage for coastal barriers, or portions thereof, that have been designated as "undeveloped" by the Department of the Interior. When the Omnibus Budget Reconciliation Act of 1981 was signed into law, it included a section prohibiting, as of October 1, 1983, the issuance of new federal flood insurance policies for any new construction or substantial improvements on undeveloped coastal barriers. Section 341(d) of the Act assigned to the Secretary of the Interior the responsibility of designating those areas to which the restriction applies.

In designating those coastal barriers along the Atlantic and Gulf coasts that are "undeveloped," the Secretary of the Interior assembled a Coastal Barrier Task Force consisting of representatives from the U.S. Geological Survey, the National Park Service, the U.S. Fish and Wildlife Service, and the Federal Emergency Management Agency. The Omnibus Budget Reconciliation Act of 1981 defined "coastal barrier" as a depositional geological feature (barrier island, barrier spit, bay barrier, or tombolo) which (1) consists of unconsolidated sedimentary materials, (2) is subject to wave, tidal, and wind action, and (3) protects landward aquatic habitats from direct wave attacks. The statute defined "undeveloped" areas as those coastal barriers, or portions thereof, containing few man-made structures and where human structures and activities do not significantly impede geomorphic and ecological processes. The Department of the Interior refined this definition to cover areas that (1) are not part of a phased development project, (2) have a density of less than one structure per five acres of fastland, and (3) lack a full complement of development infrastructure (vehicle access to each lot and a water supply, sewer disposal system, and electrical service reasonably available to each lot).

Using these definitions of "undeveloped coastal barriers," the Department of the Interior designated 188 coastal barriers and portions of coastal barriers from Texas to Maine (covering some 750 miles of ocean beach) as "undeveloped" and, therefore, ineligible for new federal flood insurance policies after October 1, 1983. The designations were based on the level of development on the ground in each area as of March 15, 1982. Ten of these areas are in North Carolina and cover about 56 miles of ocean beach. They are located at Currituck Banks, the Duck Research Center, Bodie Island (Nags

Head), Hatteras Island (Buxton), Shackleford Banks, the Onslow Beach Complex, Topsail Island (West Onslow Beach), the Lea Island Complex, Wrightsville Beach, and Masonboro Island.

While the restriction on flood insurance does not prohibit development in these areas, it is likely to have some impact on the level and quality of development in them. This new policy transfers the risk of paying for flood damages in the designated areas from the federal government back to the private sector. The policy will affect the level of development in these areas only to the extent that land development depends on the availability of flood insurance. If the private sector is willing to assume the risk, then development in the designated "undeveloped coastal barriers" will continue (subject to local and state policies).

If Congress adopts the more comprehensive Coastal Barrier Resources Act, private development on undeveloped coastal barriers is more likely to falter. The Coastal Barriers Resources Act would designate undeveloped areas similar to, if not identical to, those designated under the Omnibus Budget Reconciliation Act. It would restrict not only flood insurance, but other forms of federal assistance as well. If federal construction projects, development grants and loans, and disaster assistance were denied in the designated areas, then private development would be much less likely to occur there. Again, the Coastal Barrier Resources Act would not prohibit private development; it would simply remove any federal subsidies. Stricter controls over the location and quality of development would remain primarily the responsibility of local government.

Coastal Zone Management Act Consistency Requirements

The Coastal Zone Management Act of 1972 (CZMA), as amended, includes a set of requirements for federal actions to be consistent with federally-approved state coastal management programs. These requirements are designed to coordinate federal and state policies and decision-making concerning activities in the state's designated coastal area. Since North Carolina's coastal management program was approved by the federal government in 1978, the CZMA's consistency requirements give the state and local governments considerable leverage over federal activities in North Carolina's coastal area.

Section 307 of the Coastal Zone Management Act defines four categories of federal activities which must comply with the state's coastal management program:

1. direct federal activities, such as construction and acquisition projects;

2. federal licensing and permitting of public and private activities (excluding those on the outer continental shelf), such as Section 404 dredge and fill permits and NPDES permits to discharge water pollutants;

3. federal licensing and permitting of activities on the outer continental shelf which would significantly affect the lands and waters of the state's coastal zone;

4. federal assistance to state and local governments.

While direct federal activities must comply with the state's coastal management program to the maximum extent practicable, the other three categories require a full certification of consistency. The procedures for certifying consistency vary slightly from one category to the next, but they all center on North Carolina's Department of Natural Resources and Community Development (NRCD) reviewing proposed actions and determining if they comply with the state's coastal management program.

For example, notice of proposed direct federal activities must be provided by the federal agency to NRCD 90 days before final federal approval of the action; NRCD then has 90 days to review the project for consistency and initiate any modifications should it deem the project inconsistent. Final approval rests with the federal agency (Office of Coastal Zone Management, 1978, pp. 235-236). An applicant for a federal license or permit must supply the federal agency with a state-issued "certification of consistency"; the applicant must apply for certification to the N.C. Office of Coastal Management. A consistency determination will not be issued until the applicant has obtained all state permits required for the project; in those cases requiring a CAMA major development permit, issuance of the permit constitutes a consistency determination. In all other cases, a separate "certification of consistency" must be obtained from the Office of Coastal Management (Office of Coastal Zone Management, 1978, pp. 233-235). Applications for federal assistance to state and local agencies are routinely forwarded to the Office of Coastal Management by the state's A-95 clearinghouse. Within the time frame allowed for A-95 proposals, the Office of Coastal Management notifies the state clearinghouse whether or not the project is consistent with the state's coastal management program; this is followed by a 90-day review period (Office of Coastal Zone Management, 1978, pp. 236-239).

The consistency requirements do not apply to activities on federally-owned lands (such as national seashores and military bases) unless these activities have impacts beyond federal boundaries. In exchange for federal consistency with the state's coastal management program, the state is responsible for considering larger national interests in reviewing activities for consistency and in managing coastal resources. Such national interests include defense and environmental protection. Where national interests conflict with each other (as is often the case) and with state coastal policies, the state and federal governments must reach a compromise in allowing a particular activity to occur.

In judging the consistency of federal activities, NRCD compares them to the following state coastal management policies:

1. present and future statements of policy contained in the CAMA guidelines (North Carolina Administrative Code, Title 15, Chapter 7);

2. policies of relevant state agencies, in addition to the Office of Coastal Management, which are considered part of the state's coastal management program (such as the Division of Environmental Management's pollution control regulations and the Division of Marine Fisheries' regulations);

3. CAMA's policies and standards for development in AECs; and

4. local land use plans adopted pursuant to CAMA and approved by the Coastal Resources Commission.

This gives local governments direct influence over federal activities in coastal communities. The local land use plan, as a formal statement of local goals and policies and the desired pattern of local development, is binding on both federal and state decisions that involve "critical uses" and public investment expenditures. With "critical uses" (i.e., those identified as being of state interest), management decisions are made in accordance with the local land use plan unless this conflicts with state coastal policy. Where a conflict arises, state policy prevails. The same holds true for federal public investment expenditures (Office of Coastal Zone Management, 1978, pp. 231-232).

Following the consistency requirements set up by the Coastal Zone Management Act and the review procedures established by NRCD, the local land use plan can have significant influence over federal activities in the community. Local governments should bear this in mind while developing and adopting policies for hurricane hazard mitigation and post-disaster reconstruction. These policies should be incorporated into the local land use plan since any policies which appear in the plan must be adhered to by federal and state agencies (unless there is an overriding national interest involved or a conflict with state policy). By having hazard mitigation and reconstruction policies in the local land use plan, the community can influence federal development and acquisition projects, federal licensing and permitting decisions, and the nature of federal assistance to state and local agencies. These federal activities can all affect the community's safety from storm damages.

LOCAL PROGRAMS TO MANAGE DEVELOPMENT IN HAZARD AREAS

Whenever development presents a hazard to the public, creates conflicts between adjacent land uses, or overburdens the community's capacity to absorb it, then the local government has a duty to regulate development to reduce or eliminate these problems. In addition to this protective function, the local government can promote socially desirable uses of land to improve the economic well-being or quality of life of the community. A community's goals, or visions of its future, determine the tone of local government's policies and actions regarding development. Each community will have different problems and needs arising from the pattern and character of development within each community. People within each community will have different perceptions of how great particular problems are or whether problems exist at all.

Coastal communities may have several objectives related to managing development to reduce the risk of storm damages. In directly regulating the location, type, elevation, and design of structures, the local government may want:

1. to prevent destruction by wind, flooding, waves, and erosion that threaten the health, safety, and economic well-being of community residents;

2. to prevent water-borne or wind-borne debris from damaging adjacent properties;

3. to minimize the public expense required for seawalls, groins, flood relief, and so forth;

4. to allocate lands to their most appropriate uses; and

5. to prevent the victimization of unwary purchasers of flood-prone lots or structures.

In regulating the removal of sand and shoreline vegetation, and the construction of groins, seawalls, and bulkheads, to protect the community's natural defenses against storm damage, the local government may want:

1. to prevent accelerated beach erosion;

2. to protect dunes and other natural protective barriers;

3. to protect natural sources of sand supply which nourish beaches and prevent beach erosion; and

4. to prevent modifications to natural wave and current patterns which will increase damage by erosion, waves, or flooding (U.S. Water Resources Council, 1972, Vol. 2, pp. 130-131).

Local public policy regarding coastal storm hazards provides the rationale underlying the development management tools chosen by the community to

reduce the risk of storm damages. Public policy includes the goals, objectives, and policy statements adopted by the community to manage development. The general goal of reducing the risk of storm damages will be shared by most residents of the community; however, conflicts arise when this goal is refined and translated into specific policies which guide local government actions and place requirements on new development and post-disaster reconstruction.

Some of this conflict will arise over the extent to which government should protect the individual from his own actions: If a property owner wants to build a house where it will probably be washed away in a major storm, why shouldn't he be able to build there and face the consequences? This is a valid point, but it fails to consider the threat the individual's actions may present to the rest of the community. For example, during a hurricane, debris from a poorly-built or poorly-sited house may float or blow onto neighboring properties and cause damage to other buildings. A person who removes a frontal dune to build a home or business removes not only his own first line of defense against flooding, waves, and erosion, but also that of surrounding property owners. These are valid concerns of the community which justify local government action to control the location and quality of development. As the basis for local government actions, the stated goals, objectives, and policies of the community must show how development regulations serve the public purpose and not just protect an individual from his own actions.

Conflict may also arise in determining what is an appropriate level of risk to protect against. Regulations which require safeguards against very low-probability events (such as the 500-year flood) may be judged unreasonable, since the low probability of such a level of damages occurring may not justify the costs required to prevent them. The costs of various measures to reduce hurricane damages must be weighed against the level of damages the community can reasonably expect to face. Any local government effort to mitigate future losses must balance public needs and the desired level of protection against the costs of such protection and the willingness of individuals to assume risks.

While the above concerns deal primarily with the political and economic acceptability of local development management efforts, these efforts must also meet a number of minimum legal requirements. Local development regulations must be adopted according to the guidelines established by state enabling legislation. They must also serve valid police power objectives and reasonably aid in meeting these objectives. The regulations must not discriminate between similarly situated individuals or amount to a "taking" of private property without just compensation.

Development management tools play a useful and essential role in reducing the risk of storm damages in a coastal community. Local government officials and administrators are familiar with the basic tools of development management, such as zoning, subdivision regulations, construction standards, environmental permit requirements, and public works policies. These measures typically govern new construction and reconstruction within the community and can be used to reduce the potential for storm damages.

Reducing the risk of storm damages can be a valuable part of a broader, comprehensive development management program which regulates or influences many aspects of the community's physical development to achieve a variety of

community goals. Such a comprehensive approach is preferable because it can avoid duplicative or piecemeal regulations, address and balance the full range of needs in the community, and allow some development controls to resolve more than one problem at the same time.

The following discussion presents the different tools that local government can use to manage development and post-disaster reconstruction to reduce the risk of storm damages. The description of each tool presents the tool's general purpose, its applicability to hurricane hazard reduction, the legal, political, and economic issues surrounding the tool, and its relationship to current state and federal programs.

Zoning Regulations

Zoning is probably the most common device employed by local government to manage development. The general purpose of zoning is to avoid undesirable side effects of development by segregating incompatible uses and by maintaining adequate standards for individual uses to comply with the community's development goals. Zoning is used to control the use of land and structures on it, with more detailed standards concerning the area of a lot which may be developed (setbacks and separation of structures), the density of development (minimum lot sizes, etc.), and the height and bulk of buildings and other structures.

In North Carolina, authority to zone has been given to municipalities under N.C.G.S. 160A-381 and to counties under N.C.G.S. 153A-340. The zoning power is administered by the elected legislative body of the locality, although certain aspects may be delegated. The permissible purposes for zoning are set out in the statute as lessening congestion in the streets; securing safety from fire, panic, and other dangers; promoting health and general welfare; providing adequate light and air; preventing overcrowding of land; avoiding undue concentrations of population; and facilitating adequate provision of transportation, water, sewerage, schools, parks, and other public services. Any zoning technique applied by the local government which is found not to serve these purposes is considered illegal, because the locality may not exceed the authority granted to it by the state.

Reducing the risk of hurricane damages is a valid objective for zoning in North Carolina; witness the number of communities along the coast that have minimum elevation and beachfront setback requirements as part of their zoning ordinances and floodplain management regulations.

The main elements of a zoning ordinance are:

1. the identification of different zoning districts;

2. a list of uses permitted by right or conditionally in each district;

3. special requirements governing building placement, height, and other factors;

4. procedures for granting permits and variances; and

5. standards and procedures governing non-conforming uses and structures.

There is room in each of these elements to address hurricane hazards.

The delineation of hazard areas is an important first step in using zoning to reduce the risk of hurricane damages. CAMA AEC's, National Flood Insurance Program V-zones and A-zones, and other hazard areas can be used as districts in and of themselves or can be used as overlays to more traditional zoning districts, which separate different uses (residential, commercial, etc.) rather than different levels of hazard.

In determining which uses are permitted to locate in high hazard areas, the local government can restrict high-density uses which would be susceptible to greater levels of damage than low-density uses. It could also restrict uses in high hazard areas to those which most seriously depend on locating in that area. For example, while the oceanfront faces the greatest risk of hurricane damages, it is the only logical location for a fishing pier. The level of restriction placed on the location of different uses is primarily a choice local government must make based on the goals of the community (within the confines of state and federal programs governing high hazard areas).

For those uses permitted in different hazard areas, the local government may adopt special requirements governing construction which reasonably protect against the hazards present in each area. For example, elevation requirements and beachfront setbacks can keep buildings above expected flood levels and out of reach from erosion as well as protect sand dunes and other natural safeguards. Elevation requirements and beachfront or dune setbacks are the two most common hurricane hazard mitigation tools that appear in local zoning regulations. In using either one, the local government needs accurate information on the flood levels and amount of erosion that are likely to occur during a major storm.

Coastal communities that are enrolled in the Regular Phase of the National Flood Insurance Program have usually adopted as the minimum elevation the 100-year storm surge levels identified on their flood insurance rate maps. Those maps developed before 1982 fail to account for the height of waves that appear atop the surge and can increase surge elevations by up to 50 or 100 percent. To overcome this problem, many communities throughout the country have adopted minimum elevations that exceed the basic 100-year storm surge level and offset expected wave heights. Southampton, New York, has a zoning ordinance that requires new structures to be elevated to 15 feet, even though the 100-year surge elevation is about 12 feet (Kusler, 1982, p. 46). East Providence, Rhode Island, requires structures along the beach to be elevated to 15 feet, even though the 100-year surge elevation is about ten feet. Wrightsville Beach, North Carolina, requires buildings to be elevated at least one foot above the 100-year flood elevation.

Beachfront or dune setbacks are designed to place structures out of reach from storm-induced erosion, out of reach from breaking waves, and/or behind protective dunes. The setbacks established by the N.C. Coastal Resources Commission for ocean erodible AECs, inlet hazard AECs, and estuarine shoreline

AECs help achieve these purposes. A community along the coast can, of course, adopt even more restrictive setbacks if it feels they are necessary to protect the community from damages. Such setbacks are widely used in coastal communities throughout the country. A setback can be used not only to prohibit development but also to delineate an area within which only certain uses are permitted or certain standards apply owing to the severity of risk present.

The treatment of non-conforming uses and structures in local zoning regulations is especially relevant in dealing with post-hurricane reconstruction. Theoretically, the goal of identifying non-conforming situations is to have them eventually conform to existing regulations as they are expanded or repaired following significant damages. If not properly handled, non-conforming uses and structures can present an obstacle to reducing the risk of hurricane damages. If non-conformities remain unprotected, they will remain subject to repeated damage and may exert pressure for public expenditures to continue in high hazard areas. Of course, a local government may choose not to apply any requirements that non-conforming uses and structures eventually conform to development regulations. However, this could leave much of the community vulnerable to repeated damage. Local zoning regulations usually include some provisions with which non-conforming situations must comply. A local government basically has three options for having non-conforming uses and structures eventually meet the community's development standards:

1. requiring existing uses to conform when they are re-established after being destroyed or abandoned;

2. requiring existing uses to conform when repairs, alterations, or extensions exceed some percentage of the structure's value;

3. requiring existing uses to be elevated, floodproofed, or eliminated within some period of time whether or not they are damaged or expanded.

For various political and legal reasons, most communities opt for one or both of the first two approaches. These approaches are not without their problems.

First, the community must decide on what level of damage must occur for the use or structure to be brought into conformity with existing development standards. This is usually stated as some percentage of structural or market value. Such a figure should be low enough that it will reasonably require most, if not all, non-conforming situations to eventually be corrected. It must also be high enough to avoid what many people in the community might consider an unreasonable or costly restriction on minor repairs and additions.

The second problem involves interpretation and enforcement on the part of local inspectors. In order to determine if repairs to a non-conforming structure exceed the minimum value which would require the structure to conform, local officials must be able to accurately assess the base market or structural value as well as the value of any repairs. Such a task may prove overwhelming if a hurricane strikes the community and causes widespread damage, which local property owners will want to repair as quickly as

possible. Communities need to explore ways to expedite this process while still requiring non-conforming uses and structures to meet current development standards.

Using local zoning regulations to reduce the risk of hurricane damages can be quite effective if appropriate development standards are enacted and enforced. Many communities in North Carolina have enacted special "floodplain management regulations" to address flooding problems and to qualify for the National Flood Insurance Program. These regulations typically identify separate flood hazard zones, permitted uses, elevation, floodproofing, setback requirements, and requirements for non-conformities. The regulations tend to supplement existing zoning regulations; for example, the community may adopt A-zones and V-zones as overlays to the local zoning map. The development standards are similar to those which appear in the local zoning ordinance, but more directly address the flood hazard. There is no reason that different hazard zones and related development standards could not appear in the zoning ordinance itself. Similarly, local governments administer the Coastal Resources Commissions's development standards for minor projects in designated AECs. The AECs essentially represent another set of "districts" overlain on the local zoning map, and the CRC standards supplement local zoning regulations.

Subdivision and Planned Unit Development (PUD) Regulations

Local subdivision regulations can be used to reduce the risk of flood and erosion damages and to protect buyers of hazardous building sites. Subdivision regulations are most effective at reducing flood and erosion losses if they are used in combination with zoning, construction codes, and other regulations to ensure that lands subject to flooding and other hazards are identified and developed in ways that adjust land uses and building construction to ameliorate the hazard.

Subdivision regulations control the conversion of raw land into building sites. They can establish effective requirements and standards for public improvements (such as streets, drainage systems, and water lines). They can require the subdivider to dedicate some portion of land for public purposes (such as parks and schools). They can also regulate development to reduce burdens on existing public facilities, to prevent environmental degradation, and to mitigate natural hazards.

Cities in North Carolina have authority to regulate subdivision pursuant to N.C.G.S. 160A-371. The regulations are developed and administered by the local city council or a designated planning agency. County subdivision regulations are enabled by N.C.G.S. 153A-330 and may be exercised by the Board of County Commissioners or their appointed agency. A "subdivision" is defined as "all divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose of sale or building development (whether immediate or future) and shall include all divisions of land involving the dedication of a new street or a change in existing streets" (N.C.G.S. 160A-376).

Subdivision regulations can be used to reduce the risk of flood damages by several means:

1. prohibiting the subdivision of high hazard lands unless specific steps are taken to overcome the hazard;

2. requiring the demarcation of hazard areas on subdivision plats;

3. requiring that hazard information appear in the deeds for building sites;

4. requiring that each lot be filled or otherwise protected to provide a building site elevated above expected flood levels;

5. requiring that streets, water lines, sewers, and other public facilities be floodproofed or elevated; and

6. encouraging the clustering of buildings out of high hazard areas and the preservation of these areas in their natural state or other low-risk uses.

These means are geared to two primary objectives. They can restrict development in high hazard areas by either prohibiting it or requiring that it be adequately protected from damage. They can also ensure that a prospective buyer of a lot is adequately informed of the risk present and thus takes whatever action he feels is necessary.

Planned unit development (PUD) regulations, as a sort of hybrid of zoning and subdivision regulations, can also be used to protect development from flood and erosion hazards. PUDs are generally attractive to developers of large tracts of land. In their simplest form, PUD regulations aim to cluster development in order to preserve or avoid some section of the property involved. For example, a developer might have a 20-acre parcel of land which he could divide into 80 quarter-acre lots given existing zoning and subdivision regulations. PUD regulations could give the developer the option of clustering the 80 units on one part of the site, like away from a high hazard area, provided that the overall number of units does not exceed 80. The open space saved by clustering can be left for the common use of residents. In more complicated forms, PUD regulations can allow a variety of housing types as well as commercial and other uses. Planned unit developments are usually subject to zoning ordinances as well, and must comply with appropriate use and density requirements. However, the local government can allow some mixing of uses and increases in density.

PUD ordinances are not specifically authorized by enabling legislation in North Carolina. However, many local jurisdictions, some of them in the coastal area, have such ordinances. Their validity has not been tested in the courts. Although the possibility exists that PUD ordinances may be upheld in the absence of an enabling provision, such enabling legislation is needed on the state level to remove all doubts as to their validity.

Different forms of PUD regulations have been frequently championed as measures to protect the coastal environment by clustering development away from sensitive areas, dunes, marshes, and flood hazard areas. Currituck

County has made extensive use of a variation of the PUD process in developing a land use plan designed to protect and enhance the county's coastal resources.

As with zoning regulations, local subdivision and PUD regulations can be designed to mirror and supplement the minimum development standards that the Coastal Resources Commission maintains for AECs and the National Flood Insurance Program maintains for A-zones and V-zones. It must be remembered that these state and federal standards are minimum standards, which local standards can exceed if the community wants an additional level of protection against flooding and erosion.

Construction Standards

Building codes are especially important in protecting development from natural hazards in that they set standards for construction materials, techniques, and procedures in order to protect lives and property. Building codes vary significantly in hurricane-prone communities throughout the country. Communities in Texas do not have to adopt construction standards at all, though many, such as Galveston, have in order to protect themselves against hurricane damages. All communities in Florida must adopt a state minimum building code, but are free to choose from among five different codes that are acceptable to the state. North Carolina maintains a uniform State Building Code, with which all communities having a building inspection program must comply.

The North Carolina Building Code Council is authorized by N.C.G.S. 143-138 to establish the North Carolina State Building Code. The Building Code Council also is responsible for making changes in the State Building Code and for reviewing building laws. The Insurance Commissioner, through the Division of Engineering of the Department of Insurance, is responsible for enforcing the State Building Code. Inspection and enforcement responsibilities are relegated to local governments. Local governments may not amend the State Building Code, even by imposing stricter standards, unless such amendments are approved by the Building Code Council. All North Carolina cities are authorized (N.C.G.S. 160A-411) to have a building inspection department and must appoint building inspectors, electrical inspectors, plumbing inspectors, and other inspectors as appropriate to enforce state and local laws relating to: (1) the construction of buildings and other structures; (2) the installation of such facilities as plumbing systems, electrical systems, refrigeration systems, and air conditioning systems; (3) the maintenance of buildings and other structures in a safe, sanitary, and healthful condition; and (4) other matters that may be specified by the city council. Counties also are authorized to establish building inspection departments, but are not required to do so (N.C.G.S. 153A-350).

The local building inspector is the link between code standards and actual construction. The effectiveness of the building code depends on the inspector's interpretation of the code, his experience and technical competence, and the availability of his time and other resources needed to carry out inspections. Even in normal times, these factors are often limited in coastal communities, where part-time inspectors with limited training must try

to keep up with rapid rates of development. When the demand for damage assessment, inspections, and building permits skyrockets after a hurricane, the availability of qualified and competent inspectors is a crucial factor in determining whether or not reconstruction leaves the community any safer from the next disaster. The local CAMA permit officer (often the same person as the building inspector) is responsible for enforcing the Coastal Resources Commission's construction standards for buildings in ocean hazard AECs. The same concerns in enforcing the State Building Code in coastal communities apply to enforcing the CRC's standards, even though they are simpler and more straightforward.

A key obstacle to local regulation of construction materials and practices is local government's inability to adopt stricter requirements without the consent of the Building Code Council. The State Building Code, as it now stands, falls short in adequately protecting buildings from the damaging forces of hurricanes and other coastal storms. The Building Code Council, in seeking to maintain uniformity of regulation across the state, has been resistant in the past to allowing more stringent local standards. Another problem small coastal communities are likely to face is a lack of fiscal and staff resources to sponsor the engineering and architectural studies that the Building Code Council requires to justify any local variations to the code.

Of course, the community may rely on educating local builders and architects about building materials and practices that would provide more protection from hurricane forces than currently exists in the State Building Code. A technical manual or set of suggested guidelines could inform builders about the hazards present in the community and different ways of designing and constructing buildings to mitigate them. Such an approach could be effective, even though it depends on voluntary compliance by local builders.

Environmental Protection Regulations

Many regulations which communities adopt to protect public health and important features of the natural environment can also protect against hurricane damages. Regulations which protect dunes, wetlands, and vegetation help maintain the community's natural defense against flooding, wave action, erosion, and high winds. Regulations which protect private water supplies and sewer disposal systems from flooding and erosion can help minimize disruption and threats to public health when a hurricane or other major storm strikes the community.

Dunes and beaches provide the first line of defense against ocean waves and erosion. Beaches and dunes provide the supply of sand that fuels coastal geological processes and helps buffer development from erosion. Dunes can act as barriers to oncoming storm waves, at least until they wash away, and provide some degree of protection to development behind them. Local regulations to maintain dunes may entail setbacks from primary and frontal dunes and prohibitions against alterations to dunes by construction activities and vehicle and pedestrian traffic.

Wetlands fulfill a similar function in buffering development from wave action and erosion. Their dense vegetation and root networks help hold

estuarine shorelines in place. They also provide large and shallow areas where storm waves are likely to break and loose force before reaching buildings and other structures. Most local wetlands protection regulations either prohibit dredging and filling, restrict permitted uses to those which are water-dependent, or otherwise maintain very strict standards for development in and near wetlands. While the primary purpose of such regulations is usually to maintain their biological productivity, economic value, and aesthetic value, the regulations also provide a degree of protection against storm hazards.

Vegetative cover can dissipate the energy of waves and high winds, helping shield development from destruction. Vegetation plays a key role in the formation and stability of dunes and wetlands. Maintaining vegetative cover is important not only in dunes and wetlands but in other areas of the community. For example, homes built in dense stands of maritime forest can achieve some protection against high winds by maintaining the forest cover around the house instead of tearing it down during construction. Of course, wind and waves that are severe enough will destroy vegetative cover; fallen trees can cause a great deal of damage to buildings. Nonetheless, some types of vegetation, such as maritime forest, are adapted to withstand high winds and can provide protection. Most dense vegetation will help dissipate wave energy. Local regulations to protect vegetative cover usually appear in zoning, subdivision, and PUD regulations, though some communities, such as Sanibel, Florida, have separate regulations prohibiting the removal of certain types of vegetation.

Regulations governing the location and design of private water supplies and sewage disposal systems can also address hurricane hazards. Protecting water and sewer systems from damage accomplishes two objectives: (1) it ensures that sanitary facilities can be brought back into operation more quickly after the storm, and (2) it reduces the probability that sewerage releases will contaminate surface waters and groundwater and create a threat to public health. Local regulations can require water systems to be designed with stop valves and other devices to keep wells from being contaminated by floodwaters. Local regulations can require septic tanks to be located away from areas with high erosion potential and to be designed to prevent releases into floodwaters.

Local environmental protection regulations usually act in concert with or are adopted in response to state government regulations addressing the same resources. For example, the Coastal Resources Commission's AEC regulations and dredge and fill regulations help protect dunes and wetlands. The N.C. Division of Environmental Management (in NRCD) administers regulations for large sewer disposal systems and water wells. The N.C. Department of Human Resources maintains standards for septic tanks and for the location and protection of public water supplies. Local governments are responsible for administering CRC regulations for minor development projects in AECs. They are also responsible for regulating septic tanks with a capacity of less than 3,000 gallons per day and water wells with a capacity of less than 100,000 gallons per day.

Development Moratoria and Interim Development Regulations

A development moratorium can be extremely useful during post-hurricane reconstruction. It gives the local government time to assess damages and make sound decisions regarding reconstruction before people are permitted to repair and rebuild homes, stores, and other facilities. Without setting aside some period of time where little reconstruction or new development can occur so local officials can assess damages and review development policies and regulations, reconstruction is likely to occur haphazardly and with little regard for the community's long-term safety.

Local officials may want time to make a full and accurate assessment of damages and local development and reconstruction policies. Local officials may also want to make development requirements stricter based on whether or not existing regulations effectively minimized the level of damages. Local officials may also want time to formulate more detailed plans and policies addressing particular reconstruction problems. Development moratoria and interim development regulations provide this time.

A moratorium can be used to slow or freeze new development and reconstruction in a certain area until proper planning can take place and a permanent scheme of controls can be devised and implemented. A moratorium can be used to restrict development during a period, such as that following any natural disaster, in which extreme pressures are placed on local administrative and environmental resources. Moratoria are most commonly used in periods of rapid community expansion to give local government time to "catch up"; however, moratoria are also common in communities that have experienced massive destruction. Moratoria may also be used before disaster actually strikes the community to slow and assess development in high hazard areas.

Development moratoria do not always entail absolute prohibition of development. The term often describes a scheme of temporary prohibition and interim development regulations designed to retard development in hazardous areas and/or reorient local development and reconstruction policies.

North Carolina's enabling legislation does not explicitly grant local governments the power to use development moratoria. Total prohibition of development is not likely to be found legal, unless conditions in the community are extreme enough to warrant such. However, interim development controls, if reasonably related to the needs of the community, may be accomplished quite legally through such processes as special use permits and zoning amendments. To be valid, a moratorium must be temporary and reasonable. An indefinite moratorium is especially questionable, unless the local government can demonstrate extreme conditions and a good faith effort to strike a balance between these conditions and pressures for reconstruction and new development.

Interim development regulations must determine what types of development and reconstruction will be allowed or prohibited during a moratorium. Interim development regulations serve three functions:

1. allowing planning and ordinance writing to proceed relatively free of development pressures;

2. preventing the establishment or re-establishment of uses that will be contrary to the long-term planning and regulatory scheme before that scheme goes into effect; and

3. allowing public debate on issues related to changes in development and reconstruction.

Interim development regulations in a hurricane-stricken community might consist of several elements. They could prohibit new development for a specified period of time after the storm in which reconstruction of existing buildings can begin and local officials can deal with more pressing concerns rather than spending time reviewing new development proposals. Interim development regulations can also dictate which types of uses or structures may be rebuilt or repaired during the moratorium period. For example, they may allow the immediate repair of buildings suffering "minor" damages (below some prespecified value) while delaying or prohibiting the repair of buildings suffering "major" damages (such as those which may have been non-conforming before the storm but must now meet local development standards). Once interim development standards are devised, they can be administered through regular permitting processes. While interim standards are often adopted after damages occur, they can also be adopted beforehand in preparation for a storm.

Moratoria and interim regulations have proven to be useful in disaster-stricken communities. In 1961, Hilo, Hawaii, adopted a seven-month moratorium on new buildings and rebuilding (where damage to an existing structure exceeded 60 percent of market value) after the city was struck by a 35-foot tsunami which killed 61 people and caused 30 million dollars in property damage (Kusler, 1982, p. 44). After suffering heavy damages in a severe winter storm in 1978, Scituate, Massachusetts, adopted a moratorium on new buildings and reconstruction of old buildings along heavily damaged beach areas. Interim regulations adopted during the moratorium required new and reconstructed buildings to be elevated to 21 feet (above expected surge levels and wave heights).

Land Acquisition

Land acquisition gives a local government more control over development in hazard areas than any other technique. If the local government owns full title or substantial interests in land in hazard areas, it has full control over the use of that land. While land acquisition has obvious advantages, it can also have high costs, especially in oceanfront communities. There are, however, federal programs that provide funds for land acquisition in high hazard areas after the community or individual property owners have suffered significant damage.

The interests in land that a local government can acquire fall into two categories: fee simple and less-than-fee simple. Property ownership consists of a bundle of rights which may be purchased in whole or in part. Fee simple ownership includes the entire bundle of rights, while a less-than-fee simple interest constitutes some lesser bundle of rights. Fee simple acquisition is usually used in situations which will involve full public use of the property, such as for recreation or public buildings. When full use of the property is

not needed to meet some public goal, such as limiting development in floodplains, then local governments tend to explore cheaper less-than-fee interests. An easement is an example of a less-than-fee interest in land. Easements convey some set of legal rights over land to a second party while retaining basic title with the first party. Easements may be affirmative or negative. An affirmative easement is a right to use land, such as when a government body purchases easements for hiking trails. A negative easement prevents the primary owner from using the land in certain ways, such as when a government body purchases a scenic easement to prevent the owner from doing anything that would impair the aesthetic attractiveness of the land. Easements are particularly useful tools when regulation will not do the job and fee simple acquisition is not necessary, desirable, or cost-effective.

The general authority to acquire interests in real property is granted to North Carolina's counties and municipalities by N.C.G.S. 153A-158 and N.C.G.S. 160A-11. These general grants of authority are sufficient to empower a local government to acquire land for a public purpose, but other statutes outline specific purposes for which local governments may acquire land. N.C.G.S. 160A-457 authorizes any city to acquire property for "the conservation of open space, natural resources, and scenic areas, the provision of recreational opportunities, or the guidance of urban development." N.C.G.S. 160A-401 authorizes cities and counties to acquire easements "to preserve, through limitation of their future use, open spaces and areas for public use and enjoyment." Any acquisition, even if authorized by statute, must be able to meet the "public purpose" test. Article XIV, Section 5, of the North Carolina State Constitution clarifies the status of open space as a public purpose by authorizing the State and all local governments to acquire fee simple or lesser interests in property, by purchase or donation, "to conserve and protect its land and water for all its citizenry." The amendment mentions wetlands, beaches, open lands, and recreational areas as types of open space eligible for public acquisition.

Local governments may acquire full or partial title to land by purchase, donation, dedication, or condemnation. While local governments may purchase land at full fair market value, there are a number of ways that interests in land can be obtained for a lower cost.

A community may be able to exchange publicly-owned property in another location for property it wishes to acquire; however, the publicly-owned property must be suited to the needs of the other property owner. If land values are substantially different at the two sites, the local government may need to pay the difference. An exchange agreement requires the full cooperation of all parties and is only feasible where the local government already has title to a good deal of land.

A bargain sale is part sale and part donation, where the local government obtains title for less than fair market value. If a property owner is willing to sell his land to the local government for less than market value, he may often obtain federal and state income tax deductions for a donation equal to the difference between the market value and the sale price.

A simple donation could also grant property rights to the local government. Donations usually arise out of the property owner wanting to maintain the land in a certain way or to obtain tax benefits.

Local subdivision regulations may include a mandatory dedication, or "set-aside," requirement. This requires subdividers (1) to donate a certain percentage of area of land to the community as open space, recreational land, or for some similar purpose, or (2) to set aside land for such purposes while keeping it in private ownership. Such a provision could prove useful in minimizing development in high hazard areas.

Local governments can also obtain title to land by using their powers of eminent domain (condemnation). Condemnation, though usually unpopular when used on a large scale, may be necessary when property owners are not willing to sell or when the property owners and the local government cannot agree upon a fair market price. Condemnation can be lengthy, costly, and cause political tension in the community. It is usually used as a last resort.

Land acquisition has clear advantages in controlling development in high hazard areas and in meeting the related objectives of protecting sensitive natural environments and ensuring public access to them. However, land acquisition has some disadvantages which could affect its viability and effectiveness.

The clearest disadvantage to acquiring land in coastal communities is the cost of land. Those areas which are the most hazardous (the oceanfront and soundfront) are also the most expensive. Acquiring fee simple title to large tracts of hazardous lands would be financially impossible for a small coastal community to undertake on its own without assistance from outside sources. The local government can pursue less costly means of acquiring land (donations, state and federal funding, easements, etc.); these require a certain level of technical expertise in arranging donations and easements from private owners, securing state, federal, and private funds for acquisition, and handling appraisals, negotiations, and other phases of the acquisition procedure.

Some communities may be reluctant to acquire property not only because of its high cost but also because acquisition could remove high-value properties from local tax rolls. When local government purchases a fee simple interest, the land is removed from the tax rolls. When an easement is purchased, the property is still taxed, but at a lower level. However, even when the taxes are reduced, the local government may come out ahead for two reasons. First, the restricted property is not likely to require municipal services. Second, the taxes may be recovered by increases in the value of adjacent developed properties.

The political viability of purchasing property is largely determined by the local political climate, the costs of acquiring land, and the use for which the property is purchased. Land acquisition is a sensitive operation due to the amount of public funds involved and the complicated nature of transactions between a local government and its citizens. Most of the general public is unfamiliar with the various procedures local government can use to acquire interests in land and may be reluctant to support them. The use of condemnation is, of course, more politically volatile than acquiring land by other means.

It is not likely that coastal communities will use acquisition alone to control development in hazard areas, or use only one acquisition technique. Local acquisition programs, especially ones that involve large tracts of land,

are likely to combine fee simple acquisition with bargain sales, donations, and condemnation. Acquisition to control development in hazard areas works best in combination with development regulations and public works policies to constitute a comprehensive hazard mitigation program. While development regulations and public works policies can control the character of development in hazard areas and require certain protections against damage, acquisition may be used to deal with those areas which are most susceptible to damage and might also serve other public purposes (such as recreation, beach access, and environmental protection). Other measures may deal more effectively with less hazardous areas or lands which the public does not need for other purposes.

The period immediately following a hurricane presents a special opportunity to acquire land to prohibit further development in hazard areas and to relocate existing uses. During this time, people may be more amenable to selling, swapping, or donating their land because they have suffered significant damages and can see more clearly the hazards attending any reconstruction or further development in the area. This period is made even more opportune by the availability of various federal disaster assistance programs designed to help the local government acquire land in hazard areas and relocate existing uses (such as the Section 1362 and "constructive total loss" programs administered by the Federal Insurance Administration).

Over one hundred communities throughout the nation have used local, state, and federal funds to acquire flood-prone lands after floods, hurricanes, and other major storms and to relocate damaged and destroyed buildings (Kusler, 1982, p. 38). These communities usually adopted development moratoria to prohibit the rebuilding of structures in high hazard or heavily damaged areas. Nearly all relied substantially on federal financial assistance. After serious flooding in 1972, Rapid City, South Dakota, acquired 1,400 properties in the 100-year floodplain at a cost of 60 million dollars; the U.S. Department of Housing and Urban Development provided 48 million dollars of this through an urban renewal grant (Kusler, 1982, p. 38). With 4.5 million dollars provided by a HUD Community Development Block Grant and the Corps of Engineers, Prairie du Chien, Wisconsin, is purchasing and relocating 128 repeatedly-damaged properties (Kusler, 1982, p. 38). After the Ash Wednesday storm in 1962, Sea Isle, New Jersey, adopted restrictions on rebuilding a heavily-damaged strip of coastal development; the town used $600,000 from the state's "Green Acres" program to acquire 183 of the properties for a park (Kusler, 1982, p. 53). After Hurricane Frederic in 1979, Gulf Shores, Alabama, is combining donations, funds from the Section 1362 program and Department of the Interior, and development restrictions to acquire certain heavily damaged oceanfront properties.

Compensatory Regulations and Transfer of Development Rights (TDR)

Both of these techniques are hybrids of development regulation and land acquisition in that they compensate landowners in exchange for restrictions on the use of their land; compensation is provided to save very restrictive regulations from being struck down by the courts as a "taking" of private property. Both techniques could be used to restrict development in hazard areas; however, neither technique has been widely used, and their usefulness remains uncertain.

Compensatory regulations are drafted to give the local government the option of compensating a landowner for the restriction of his property. The State of Rhode Island has adopted legislation which compensates owners of wetlands for restrictions on their use. The City of Dayton, Ohio, has passed an ordinance restricting the land surrounding an airport to low-density uses and providing an administrative procedure by which "taking" claims can be filed and compensated.

It is not clear whether existing North Carolina legislation enables local governments to use this type of compensatory scheme. Zoning enabling legislation combined with the power of eminent domain could, arguably, allow a local government to enact compensatory land use regulations, but their legal status remains unclear. Compensatory regulations could be challenged as authorizing public expenditures for non-public purposes and being beyond the scope of enabling legislation.

Compensatory regulations have heretofore not been used in North Carolina. They would appear to be politically feasible in that they compensate property owners for severe land use restrictions. The main problem facing compensatory regulations is funding, especially if a local government applies them widely.

Transferable development rights (TDR) schemes compensate restricted landowners less directly; instead of having the local government pay restricted landowners, TDR schemes have other landowners pay restricted landowners. The basic concept underlying TDR is that ownership of land gives the owner a bundle of rights, each of which may be separated from the rest and transferred to someone else. The right to develop the land is one of these rights. Under a TDR system, an owner can sell his development rights to another property owner who is required by statute to collect a specified number of development rights before developing his or her own property.

Under a typical TDR system, the government awards a certain number of development rights to each parcel of developable land in the community based on the acreage or value of the land. The system is usually set up so that no owner possesses enough development rights to develop all of his property without buying some rights from someone else. Persons can sell their development rights on the open market because they do not want to develop their property or are prohibited by some regulation from developing their property. Land from which development rights have been sold cannot be developed.

The initial decision on the number of development rights to be issued sets the overall density of the community as well as the maximum quantity of new development (at least until there is an affirmative decision to issue more development rights). Under some TDR proposals the quantity of different types and subtypes of development is controlled by restricting the amount of land that can be developed for particular uses. Alternatively, the mix of uses can be controlled by a system which allocates commercial rights, residential rights, and other types of development rights instead of "general purpose" development rights.

TDR is designed to reduce the value shifts and inequities of traditional zoning by allowing the market to compensate owners who, under a normal zoning scheme, would have the development potential of their land restricted with no compensation. In addition to being proposed as a basic replacement for

zoning, TDR has been suggested as a means of preserving open space, ecologically sensitive areas, and hazardous areas. TDR proposals generally suggest that the local government designate some areas where, for environmental or other reasons, development is not allowed.

New state enabling legislation will probably be required in North Carolina before a local government could implement a TDR system. The novelty of the TDR concept and its break with traditional notions of property rights present political obstacles to its use in North Carolina, even though a TDR scheme could, if properly designed, be quite effective and fair.

TDR schemes require a high level of expertise and staffing to design and administer them. Studies would be needed (1) to investigate the costs and inefficiencies of current development practices, (2) to document and analyze the objectives to be obtained through better regulations, (3) to outline the rights of property owners under the TDR system, (4) to equitably allocate initial development rights, and (5) to design an equitable and manageable market system for the sale and exchange of development rights. Despite these complications, a TDR scheme is currently being used effectively in the small town of St. Georges, Vermont (with about 500 residents) to focus its growth and preserve its village atmosphere.

Collier County, Florida, uses a variation on TDR as part of its zoning regulations. The county authorizes the transfer of development rights from its "Special Treatment Overlay Zone" (which includes wetlands, beaches, and barrier islands) to areas which are better suited to development. Some of the difficulties the county has faced are the high costs of designing and applying the TDR scheme, law suits over property valuations, and a lack of understanding by property owners (Ralph M. Fields and Associates, 1981, p. 55).

Public Facilities Siting and Design

Local government can use its policies governing the siting and design of public facilities to influence development in hazard areas. Local policies restricting the provision of public services to hazard areas, or requiring that public facilities be located and designed to withstand hurricane forces, can work toward three goals:

1. limiting the type and density of development in hazard areas;
2. minimizing the disruption of water, sewer, and other services when a storm strikes the community; and
3. reducing the costs of providing and repairing public facilities.

By coordinating its utility siting and extension policies with land use regulations, the community can exercise substantial control over the type, density, and amount of development in high hazard areas. The location of public utilities, such as water lines, sewer lines, and roads, has a strong influence on the location of development. A decision not to extend services to a specified area can make development there either more expensive or less

feasible if property owners must rely on individual water supplies and septic systems. Areas where the local government supplies water and sewer services are likely to develop at higher densities than areas without these services, unless the services are supplied by a private developer (as is often the case in North Carolina's coastal communities). Using utility location and extension policies to control development in hazard areas is less expensive than land acquisition and less subject to legal challenges than highly restrictive land use regulations. While there are a number of advantages to this approach, it has its limits. Unless land use regulations are also applied in hazard areas, development will continue in these areas, albeit at lower densities, by relying on private water supplies, septic systems, and roads.

Local policies governing the location and design of public facilities can also minimize service disruptions caused by major storms and reduce the cost of providing these services by avoiding repeated damage to public facilities and utility networks. Local governments can minimize disruptions and long-term maintenance costs by requiring public facilities to be adequately protected from hurricane damages, such as requiring them to be adequately buried and not locating them in erosion-prone areas. The same requirements that apply to public facilities and utility systems could be made to apply to private utilities. For example, local subdivision regulations can require the subdivider and developer to locate and design roads, water lines, and sewer systems to resist damage by flooding, winds, and erosion. A local government could also require electrical lines to be buried to minimize storm damages and the danger of downed power lines.

Using public facilities policies to control growth in hazard areas is somewhat limited by the statutory and case laws of North Carolina. Once it provides service to any inhabitants within the city limits, a city must provide equal service to all inhabitants. A local government may be subject to "equal protection" challenges if it fails to provide services to one property owner after it has granted service to a similarly situated property owner. The key here is whether or not property owners in high hazard areas are situated similarly to people in less hazardous areas; one could argue that they are not. A local government can exercise discretion over whether or not it extends services into a particular area, especially when such an extension creates disproportionate costs for the local government. The costs of damage prevention measures and the likelihood of repair costs for utility extensions may impose a disproportionate expense on the local government and justify its decision not to provide some facilities in high hazard areas; such a justification will depend on the particular situation. Further justification for limiting services in high hazard areas can come from showing that such a policy is part of a more comprehensive scheme of development policies (land use regulations, etc.) that the local government is using to limit development in hazardous areas. The law is less clear in determining whether or not the local government is obliged to rebuild or reinstall facilities after they are substantially damaged in high hazard areas where the local government wants to restrict development. Again, the legality of such a decision would be enhanced if the local government also had land use or building regulations restricting the reconstruction of private homes and businesses in heavily damaged areas.

The political viability of using public facilities policies to limit development in hazard areas will depend on how restrictive they are. Moderately restrictive policies will be more palatable to local developers and property owners than will highly restrictive policies. Local governments may feel compelled to extend utilities to hazardous areas that are already developed, even though they may not be legally required to do so.

Any public facilities extensions must comply with state and federal laws. There are state regulations governing the location and design of roads, public water supplies, and sewer facilities (outlined in the previous section on state programs); these provide some measure of protection against flood and erosion damages. Any public facilities involving the expenditure of federal funds must comply with federal floodplain management regulations (namely, Executive Order 11988) to reduce the risk of damages. Regarding the reconstruction of public facilities after a major storm, federal disaster relief is made available to local governments, primarily under FEMA's "Repair or Restoration of Public Facilities" program which currently covers only 75 percent of the cost of repairs.

Comprehensive Planning

Before formulating and adopting regulations, land acquisition programs, public facilities standards, and other policies addressing hurricane hazards, the community should engage in a comprehensive planning effort. By incorporating and analyzing hazard information in a comprehensive plan, the local government can provide a sound basis and justification for those approaches that it decides to pursue in managing development and post-disaster reconstruction. Comprehensive planning also gives the community a forum for addressing and balancing a full range of local development objectives, not just those related to natural hazards. Local economic, social, and environmental objectives and policies may conflict with each other, be slightly inconsistent, or duplicate each other. The comprehensive plan should be the place where such problems are resolved and specific courses of action are charted to reach local objectives.

Regarding storm hazards, comprehensive planning performs two functions:

1. it balances hazard mitigation against the community's other objectives to determine what level of protection the community wants; and

2. it helps the community identify particular hazard mitigation problems and select the approach, or approaches, that it wants to take to address them.

Local governments will probably not be using any one of the techniques described above in isolation; they will probably be using a variety of techniques to control different aspects of new development and reconstruction. Most communities in North Carolina's coastal area already have basic land use regulations in place (zoning, subdivision, etc.). These can be amended to include protections against high winds, flooding, wave action, and erosion if they do not already provide such protection. Some communities may want to

explore new techniques that can help reduce the risk of storm damages effectively and efficiently. A good comprehensive plan will take steps to identify hazard areas, to assess the community's vulnerability to storm damages, to identify hazard mitigation needs, to review current local measures governing new development and reconstruction, and to review other approaches the community could pursue.

Local land use plans prepared in compliance with the Coastal Area Management Act, as basic comprehensive planning documents, provide a logical place for communities to identify and address hazard mitigation and reconstruction problems. By incorporating a more detailed analysis of the community's hurricane hazards into the local land use plan, the local government will be prepared to balance hazard mitigation against other needs and objectives. The local government will also be prepared to select an appropriate course of action that will make the community safer from hurricanes and other major storms.

The following chapters describe processes to use in analyzing hazards in the community and in planning for hazard mitigation and post-disaster reconstruction. To be most effective, these processes should be incorporated into a local comprehensive plan. The approaches chosen by the community to reduce the risk of storm damages may satisfy other needs in the community (such as protecting fragile natural areas or providing beach access); a good comprehensive plan will point out such opportunities. The approaches chosen by the community to reduce the risk of storm damages may also conflict with other needs of the community (such as maintaining the tax base or reducing the costs of development regulations); a good comprehensive plan will iron out such conflicts and identify approaches the community should take to meet different objectives.

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CHAPTER 5:

PLANNING FOR HURRICANE HAZARD MITIGATION

Up to this point, this report has presented information on the hazards that hurricanes and other major storms pose to coastal communities. It has also presented information on local, state, and federal programs which address these hazards by influencing new development and reconstruction in the community. This chapter presents a process that the community can use before disaster occurs to mitigate the hurricane hazard. It helps the community tie together information on storm hazards and information on development management measures as a basis for local hazard mitigation and reconstruction planning. The process consists of six major steps (see Figure 5.1) to identify the community's vulnerability to hurricane forces, to identify and select hazard mitigation measures, and to implement these measures and integrate them into the community's existing land use, capital improvements, and emergency operations plans.

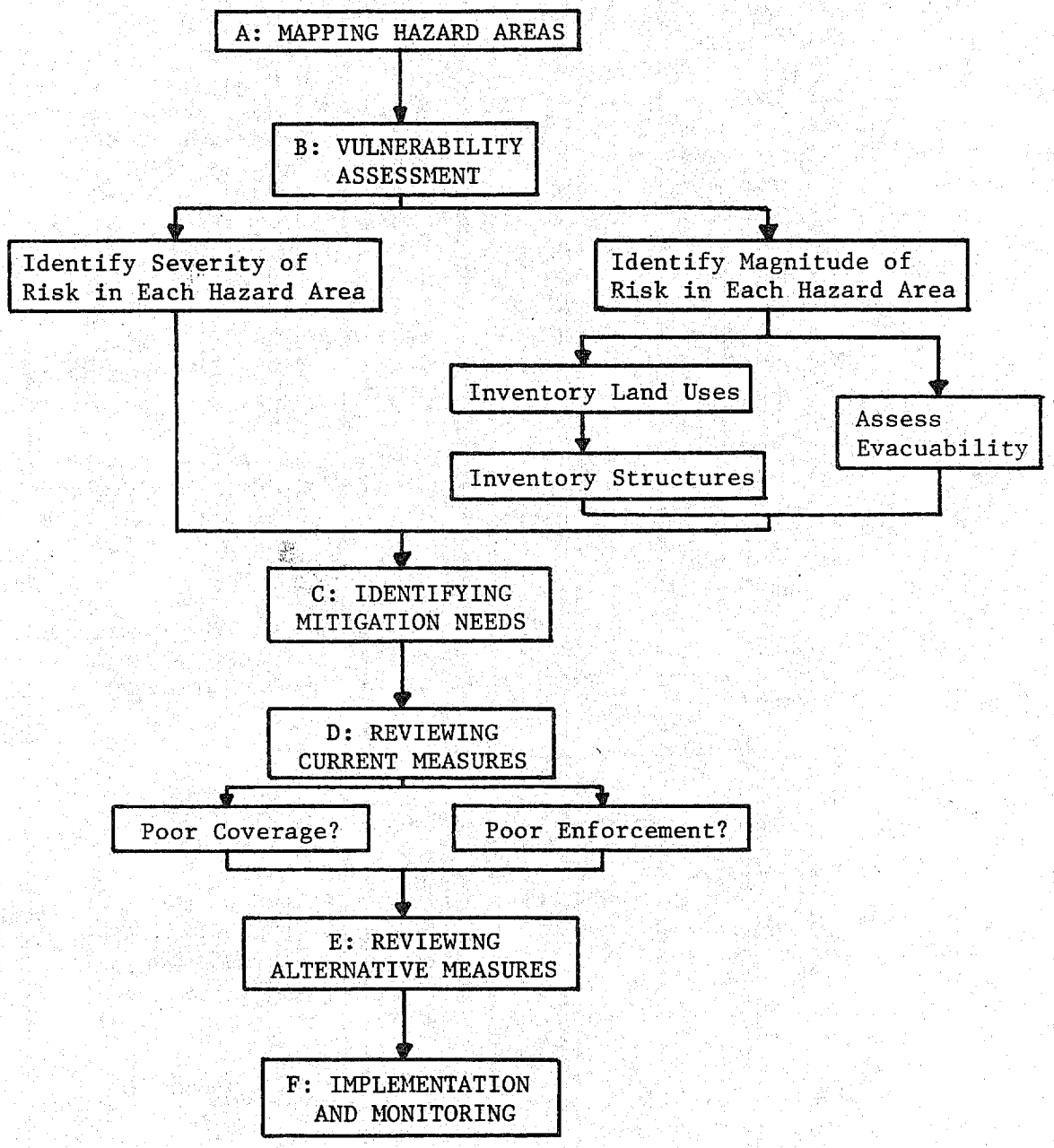
The process allows individual communities to come up with approaches for managing new development and reconstruction that are tailored to their own unique conditions. Each community has different problems in the face of the hurricane hazard which must be addressed differently. For example, a relatively undeveloped community will probably be more interested in guidelines for new development; a community that is already heavily developed will probably be more interested in guidelines for reconstruction. The process can apply equally to formulating guidelines for new development and guidelines for post-disaster repairs and reconstruction. Certain techniques for managing new development and reconstruction to reduce the risk of future storm damages will be more politically acceptable and/or more administratively feasible in some communities than in others. Using the process, a local government can address these issues, identify its particular hazard-related problems, and take action to resolve them.

MAPPING HAZARD AREAS

The first step in any hurricane hazard mitigation effort is the identification and mapping of those sections of a community which are most vulnerable to hurricane damages. The coastline of North Carolina is in a state of flux in response to constant water, wave, and wind forces. During a hurricane, all of these forces are temporarily intensified, creating a significant hazard for human activities along the coast. Even though the entire shoreline is continually changing, some areas are more hazardous than others, especially during a hurricane. Delineation of these areas serves as a necessary guide for managing development in a coastal community, regardless of whatever planning tools (such as zoning or building standards) are used to reduce potential hurricane damages.

Hazard area delineation could pose a formidable task for the typical local government due to the amount of scientific and probabilistic information about hurricane forces required to estimate storm surge elevations, wind speeds, and other "design" criteria. Fortunately, most of this technical work

Figure 5.1: A Process for Mitigating the Hurricane Hazard



has already been done or sponsored (and is continually modified) by federal and state agencies in response to legislative and administrative directives. This work has led to the widespread acceptance of certain "design events" (such as the 100-year flood or 100-year wind storm) as guidelines for federal, state, and local decision making. Similar work has been done to identify environmentally sensitive areas and areas of potential future erosion or shoreline change. All of this work must determine some threshold levels or boundary lines to delineate where protective public policy is to take effect in order to reduce hurricane damages.

The two state and federal programs which provide the most guidance for delineating hazard areas in North Carolina's coastal communities are the North Carolina Coastal Area Management Act (CAMA) and the National Flood Insurance Program (NFIP). Local governments have already adopted some hurricane hazard mitigation techniques in response to local needs, CAMA's regulatory program for development in areas of environmental concern (AECs), and federal requirements for particiapation in the NFIP. In addition to the hazard areas identified by CAMA (AECs) and NFIP (V-zones and A-zones), a community wishing to reduce future hurricane damages may consider other vulnerable areas (especially on barrier islands) in its standards for hurricane hazard mitigation.

The boundaries of the five AEC categories relevant to hurricane hazards (ocean erodible areas, high hazard flood areas, inlet hazard areas, coastal wetlands, and estuarine shorelines) have to a large extent already been determined by the Coastal Resources Commission and the local governments along the coast to carry out CAMA's land use planning initiative and to administer the AEC development permit program. Referring to the community's CAMA land use plan and the CAMA regulations for AECs (Title 15, Subchapter 7H of the N.C. Administrative Code) will give local administrators an excellent starting point for identifying areas in the community most subject to hurricane forces and for identifying methods by which the community can avoid or resist these forces.

The North Carolina coast contains communities that are enrolled in either the Emergency Phase or the Regular Phase of the National Flood Insurance Program. In Regular Phase communities, the FIA's flood insurance rate maps are important references for delineating hurricane hazard areas in that they define A-zones and V-zones which are subject to flooding and wave action in the 100-year storm. A-zones, V-zones, and AECs may be used singly or in combination to develop local hazard mitigation measures that are geared to the different types and levels of risk which exist in these different zones.

Communities enrolled in the Emergency Phase must operate with slightly less sophisticated information in delineating hurricane hazard areas. The Emergency Phase's flood hazard boundary maps identify preliminary "special flood hazard areas" but do not include the more accurate estimates of base flood elevation that determine the A-zones and V-zones appearing in the Regular Phase's flood insurance rate maps. Local administrators in Emergency Phase communities should keep well apprised of the progress made by the technical studies leading to the development of flood insurance rate maps and the community's enrollment in the Regular Phase. While it is still enrolled in the Emergency Phase, a community that wants to begin delineating hurricane hazard zones and formulating hazard mitigation measures can begin with the preliminary flood hazard areas designated on its flood hazard boundary maps.

As with A-zones and V-zones, these areas can be used singly or in combination with AECs to identify areas where different levels of risk exist. This should provide a good starting point for developing local hazard mitigation guidelines. The boundaries within which these guidelines apply can always be adjusted in the future as more accurate information on flood levels becomes available, A-zones and V-zones are delineated, and the community enters the Regular Phase. The Federal Insurance Administration is scheduled to have flood insurance rate maps completed for all oceanfront communities in North Carolina by the end of 1983, paving the way for their entry into the Regular Phase.

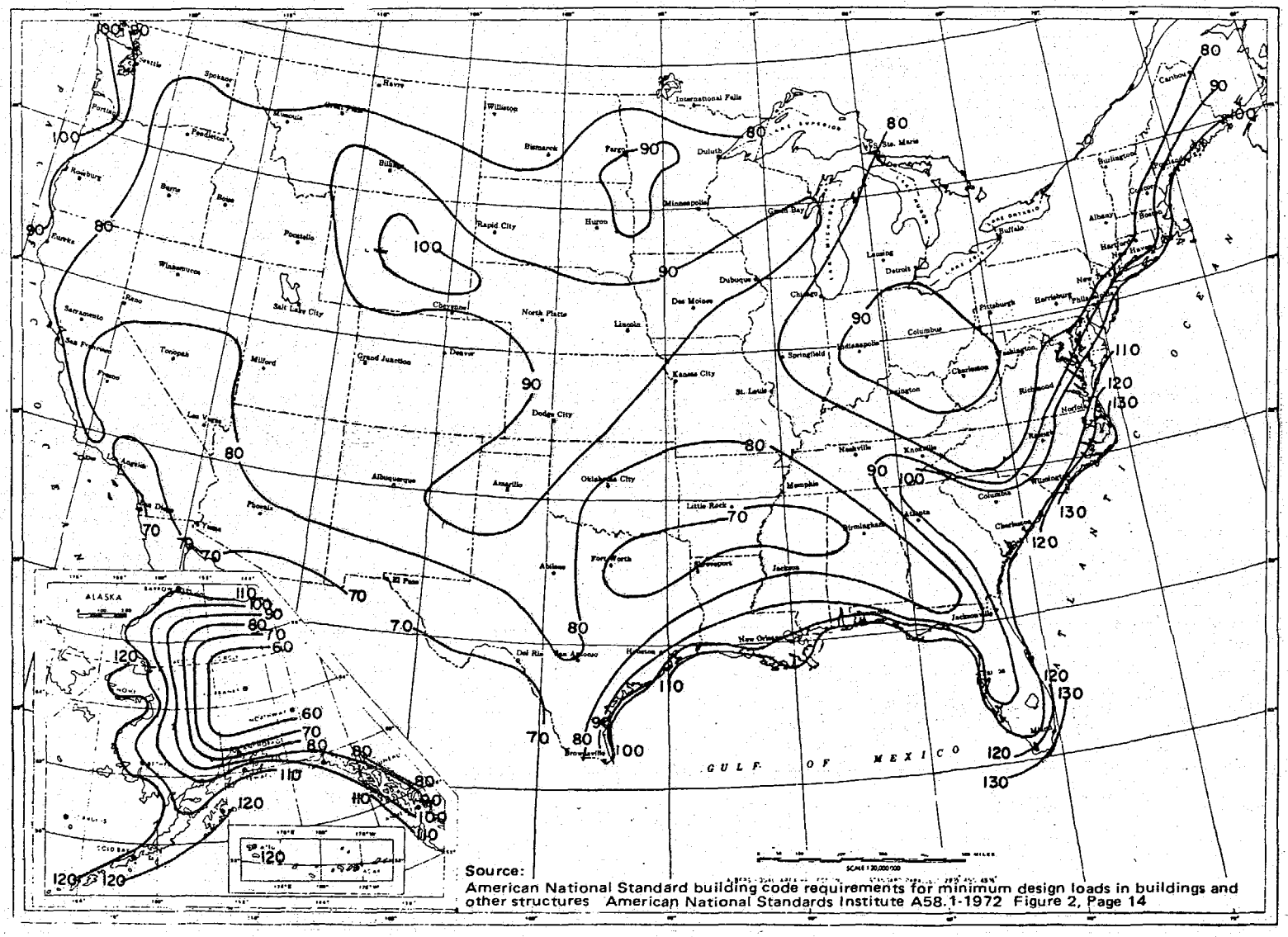
It is important to note that the hazard areas identified under CAMA and the National Flood Insurance Program provide a base set of hazardous areas that all communities should use for hurricane hazard mitigation. Each community could delineate other areas which it considers hazardous in the face of major storms based on local history, geological studies, and other local information. Such areas may not always be located within AECs or the NFIP's designated flood hazard areas.

The discussion above has dealt with hazard area delineation only with respect to the water forces associated with hurricanes (flooding, waves, and shoreline erosion). Powerful winds are the other key hurricane force presenting a hazard to coastal communities. (Indeed, they are what make hurricanes unique.) However, wind hazard areas within a coastal community cannot be delineated to the same detail as flood hazard areas. There may be some minor variation in hurricane wind speeds among different sections of the community (due to topography and vegetative barriers), but the entire community will, by and large, be subject to the same wind velocity because of a hurricane's size and power.

Even though it is not possible to differentiate estimated hurricane wind speeds within a single community, it appears that some variation exists within the state of North Carolina. The design wind speeds used in the State Building Code illustrate this variation (Figure 4.1). Also, in 1972, the American National Standards Institute (ANSI) determined the "100-year fastest wind speeds" for different parts of the country. This is the wind speed that has a one-percent chance of being equalled or exceeded in any given year. This information is intended for the establishment of building code requirements for withstanding wind loads. As shown in Figure 5.2, annual extreme fastest wind speeds in coastal North Carolina range from 110 to over 130 miles per hour. This is not much of a variation, but ANSI's wind speed determinations should play a major role in any construction standards a community adopts to mitigate hurricane damages.

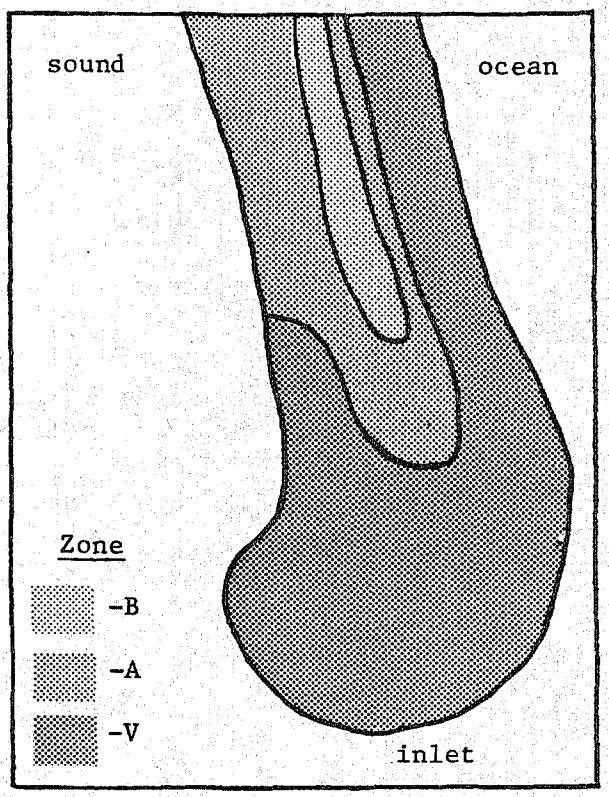
The boundaries of AECs, V-zones, A-zones, and flood hazard boundary map "special flood hazard areas" can be combined in simple overlay fashion to determine different areas in the community where different levels of hurricane risk appear (see Figure 5.3). Identifying these hazard areas will not only facilitate the formulation of mitigation measures appropriate to the level of risk in each area; it will also provide a guide for reconstruction activities (when a major storm does occur) and for public works investment decisions.

Figure 5.2: Annual Extreme Fastest Wind Speed in Miles Per Hour
(39 Feet Above Ground, 100-Year Mean Recurrence Interval)

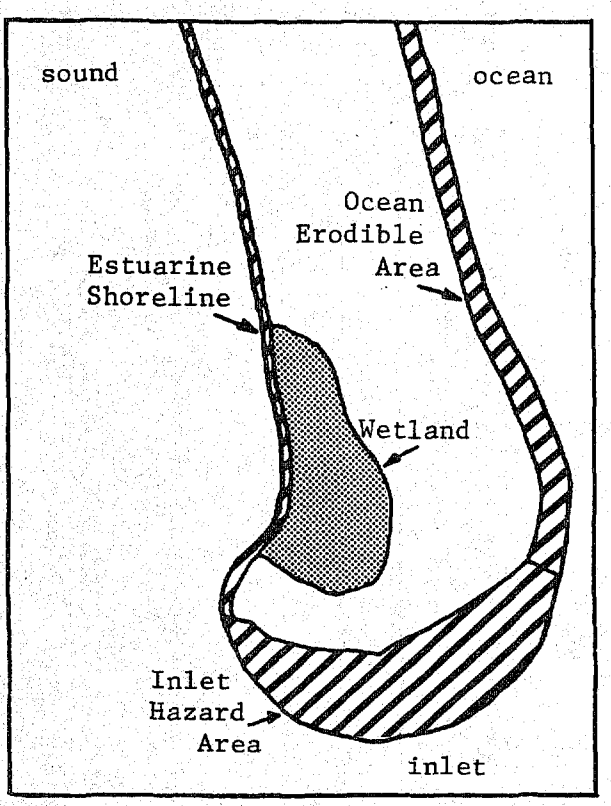


Source: Dames and Moore, 1981, p. 42.

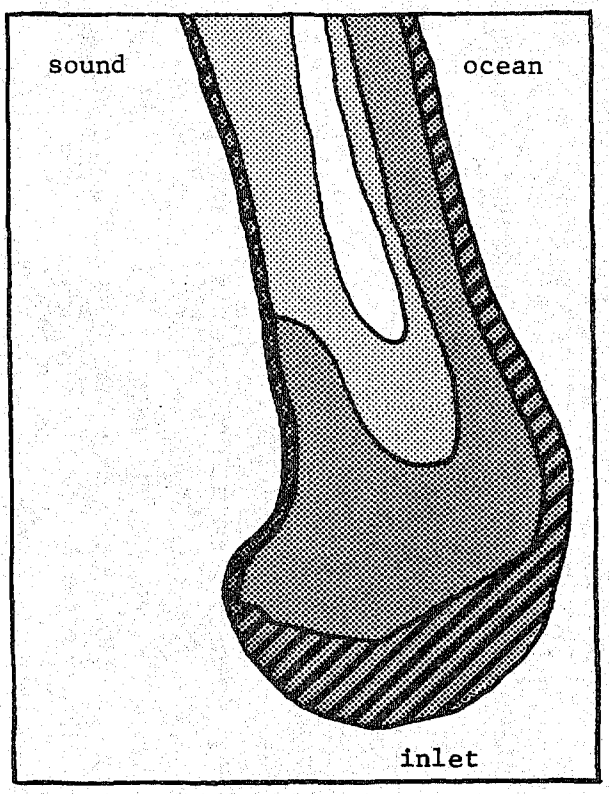
Figure 5.3: Composite Hazard Overlay



National Flood Insurance Program Zones



CAMA Areas of Environmental Concern
(also includes oceanfront V-zones)



COMPOSITE HAZARD MAP

Hazard Area	Level of Risk
-1	Highest
-2	High
-3	Moderate
-4	Lowest

ASSESSING THE COMMUNITY'S VULNERABILITY TO HURRICANE DAMAGES

Once the community has identified those areas which are most subject to hurricane forces, it can begin evaluating the level of hazard present throughout the community. Such an assessment of the community's vulnerability to hurricane damages is necessary for identifying the most important hurricane-related problems in the community and in targeting the community's hazard mitigation efforts to its most vulnerable areas.

A comprehensive assessment of the community's vulnerability to hurricane damages must include an identification of both the severity and magnitude of risk that exist in each hazard area. The severity of risk is basically a function of the number of physical forces (storm surge, wave action, etc.) that a hurricane is likely to impose on a particular hazard area. The magnitude of risk is basically a function of the size of the population and the number and value of developed properties exposed to hurricane forces within a hazard area.

Severity of Risk

Figure 5.4 ranks the severity of risk in each hazard area according to the damaging forces which are likely to occur there. This breakdown is the basis for the ranking of the different hazard areas which appear in Figure 5.3.

Figure 5.4: Severity of Risk in Hazard Areas

Hazard Area	Exposure to Damaging Forces				
	Severity Rank	Erosion/ Scour	Wave Action/ Battering	Flooding	High Wind
Ocean Erodible AEC	1	●	●	●	●
Inlet Hazard AEC	1	●	●	●	●
Estuarine Shoreline AEC	1	●	●	●	●
V-zone	2	o	●	●	●
Wetland AEC	2	o	●	●	●
A-zone	3			●	●
Rest of Community	4				●

Exposure Level: High (●), Moderate (o), Low ( )

CAMA's ocean erodible AECs, inlet hazard AECs, and estuarine shoreline AECs will bear the full force of a hurricane since they lie directly on the land-water interface and are the most dynamic features of the coastal landscape. Shoreline erosion, inlet migration, and inlet formation pose day-to-day hazards for coastal development; hurricanes and other major storms accelerate these processes so that drastic changes in the local landscape can occur in a few hours. During a hurricane, development in ocean erodible

areas, inlet hazard areas, and estuarine shorelines areas will be subject to severe erosion and scour, direct wave action, battering by debris, inundation by the storm surge, and high winds. Erosion and wave action present a sizable hazard along the shores of North Carolina's broad sounds, where large areas of open water promote significant surges and high waves during a major storm. As with the ocean shoreline, the estuarine shoreline is in a constant state of flux, and major storms accelerate the everyday process of shoreline change. Wetlands will be subject to wave action, flooding, and high winds, but are less susceptible to erosion.

The National Flood Insurance Program's V-zones will overlap with ocean erodible AECs and inlet hazard AECs and will be subject to similar damaging forces. They will in some cases also overlap with estuarine shoreline AECs. Those portions of the V-zone farthest from the beach will be somewhat less prone to severe scouring; nonetheless, the V-zone is still an area of especially high hazard.

The National Flood Insurance Program's A-zones are subject to inundation and high winds. A-zones are those parts of the community which have a one-percent chance of being flooded in any given year. A-zones are not likely to be affected by significant scour and wave action, although some undermining of structures has been known to occur in A-zones as flood waters rise and recede. Development along the A-zone/V-zone boundary may be subject to the forward momentum of breaking waves.

All other sections of the community will be subject to high winds but will remain relatively safe from the other damaging forces of a hurricane. Of course, a catastrophic hurricane can unleash the full complement of damaging forces beyond the boundaries of any hazard area. One must bear in mind that the delineation of V-zones and A-zones is based on probabilistic information regarding the elevation of a flood that has a one-percent chance of occurring in any given year. Hurricanes frequently exceed this "one-percent" or "100-year" event even though the "one-percent" flood, as a flood which can be reasonably expected to occur in a community, is the commonly accepted basis for analysis and regulation. Likewise, the delineation of AECs under the CAMA program is based on scientific information regarding coastal geology, ecology, winds, water currents, and waves. A major hurricane can easily cause extensive damages outside ocean erodible areas, inlet hazard areas, and estuarine shoreline areas due to unforeseen and unaccounted characteristics or "weak spots" of the local landscape.

Depending on the amount of scientific and historical information available in the community regarding such "weak spots," the community may delineate locally-important hazard areas that are not covered by AECs, A-zones, or V-zones. Such locally-important hazard areas might include overwash areas or drainage channels which have been repeatedly inundated during major storms. The severity of risk occurring in these areas can then be judged and ranked among the other hazard areas as a guide for targeting hazard mitigation efforts.

Magnitude of Risk

Identifying the magnitude of risk in the community requires identifying the characteristics of development within each hazard area by performing a basic inventory of land uses and structures. This inventory will give local residents and administrators a clearer picture of the types and levels of development exposed to different levels of hazard, thus pointing out particular areas or issues of concern. By keeping it up to date, decision makers can have an accurate basis for plans and actions when a severe storm hits the community.

The first level of analysis for identifying the magnitude of risk is a simple inventory of land uses in each hazard area. The land use inventory can determine the types and acreage of different land uses in each hazard area to identify development trends which may increase the potential for damages and need to be addressed in the community's hazard mitigation and reconstruction planning. The land use inventory should not require much time or effort since the information can be readily drawn from existing land use maps (such as those prepared under CAMA). In addition to looking at existing patterns, the inventory needs to consider expected future land use patterns. An undeveloped hazard area poses no risk to development, but once the area develops, the risk increases and will call for some means of hazard mitigation.

The second level of analysis for identifying the magnitude of risk is an inventory of structures in each hazard area. This will require more effort than the land use inventory but will yield more detailed information and a more specific understanding of the types of hazards present. The structural inventory can be divided into a residential inventory, a commercial inventory, and a public facilities inventory.

An inventory of residential structures begins with a count of the number of dwelling units and density present (and expected) in each hazard area. All other things being equal, a more densely developed hazard area presents a greater risk of damages than a less densely developed hazard area. It would be useful to take the residential inventory a few steps further to identify such conditions as (1) the number of mobile homes in each hazard zone, (2) the replacement or structural value of individual buildings, and (3) the number of residences pre-dating existing building codes or not built in accordance with guidelines for flood insurance or other local and state programs. Some of this detailed information will be available from local property tax and building inspection records. Gathering it will require more time and effort but will refine the local government's understanding of the types and levels of hazard present in the community.

An inventory of commercial structures begins with a count of the number of business establishments in each hazard area. The magnitude of risk to commercial development can be more sharply defined by accounting for the number of people employed at each establishment and the structural or replacement value of each establishment. The commercial inventory should also account for the number of structures which pre-date existing construction standards and/or do not comply with local construction guidelines which reasonably guard against flooding, erosion, and wind damage. Communities have a stake in ensuring the safety of commercial establishments from hurricane damages; the more damages that are sustained by the business sector, the

greater will be the economic disruption caused by a hurricane and the longer it will take the community to recover.

An inventory of public facilities, utilities, and private institutions will serve two purposes: (1) it will provide a basis for assessing the ability of essential community services to function during and after a hurricane disaster, and (2) it will guide the local government in the siting and design of public buildings and utilities. Facilities located in a particular hazard area should be designed to withstand the damage forces expected in that area. This is especially true for facilities which play a key role in disaster response operations and are essential to quick community recovery. Primary roads must be adequate to permit the safe and timely evacuation of residents and tourists. Water, sewer, electrical, and telephone facilities need to withstand the storm and be brought back on line quickly afterward. Police stations, fire stations, town halls, and county courthouses usually are headquarters for emergency operations and should be safe from storm forces. Schools, which usually serve as temporary shelters during a disaster, should also be safely designed and located. Similar concerns apply to public and private health care facilities. The facilities inventory should identify the location of each facility relative to the different hazard areas, each facility's ability to withstand the damage forces expected in its hazard area, and the facility's replacement value. The inventory should also consider each facility's importance to disaster operations and the function and population each facility will have to serve during the recovery stage.

Community Evacuability --

In addition to assessing the community's vulnerability to property damages, the local government should assess the community's ability to evacuate in the event of a major storm and thus avoid losses of life. The amount of time it takes for the community to safely evacuate depends on the level of development and number of people in the community at any one time. It depends on the condition of roads and bridges along the evacuation route. It also depends on the attitudes of local residents and visitors and the strength of a particular storm.

Evacuation time has four components: mobilization time, travel time, queueing delay time, and pre-landfall hazards time.

> Mobilization time is that period between the issuance of the evacuation order and the departure time of the last vehicle from the vulnerable area. It depends to a large extent on the attitudes and response time of residents. Travel time is the period necessary for the vehicles to travel the length of the evacuation route at an anticipated operating speed assuming no traffic delays (queueing). Queueing delay time is defined as the time spent by vehicles in traffic jams resulting when the capacities of the evacuation routes are exceeded by the number of vehicles entering those routes. (Stone, 1982, p. 8)

Mobilization time, travel time, and queueing delay time together constitute the community's "clearance time" -- the total time needed to move all evacuees to temporary shelter once an evacuation order is issued. Pre-landfall hazards

time is the time before the eye of the hurricane reaches the community when the storm surge or sustained high winds render evacuation routes impassable. The National Hurricane Center issues warnings based on its predictions of the time the eye is expected to reach land. However, the storm surge and sustained winds can strike the community hours before the eye does. This pre-landfall hazards time cannot be used for safely moving evacuees; it is greater for more intense storms.

Estimating these various components of evacuation time remains a complicated task due to uncertainty regarding the intensity, timing, and other characteristics of any particular storm and uncertainty regarding the willingness of local residents and visitors to evacuate. An effort is currently underway in North Carolina to simplify evacuation time estimation techniques (see Stone, 1982). Current estimation techniques involve:

1. estimating storm surge levels, wind speeds, and their time of arrival before the eye's landfall for storms of different intensities;

2. identifying points along the evacuation route that are subject to flooding;

3. estimating the total number of people and automobiles that must be evacuated;

4. estimating the carrying capacity of roads along the evacuation route;

5. identifying any bottlenecks or other points along the route that could delay traffic;

6. estimating the timing of traffic movement and traffic levels along the route; and,

7. estimating the time it will take people to respond to an evacuation order.

Nearly all communities in the CAMA coastal region have prepared hurricane evacuation plans with guidance from the N.C. Division of Emergency Management; these plans include estimates of needed evacuation times. Coastal communities need to include all of the considerations listed above in deriving these estimates. While estimation remains an inexact science, the community needs to derive the best estimate possible so it can plan to have enough time to safely evacuate.

Much of the evaucation time needed boils down to the level of development, resident population, and visitor population in areas that need to be evacuated, relative to the carrying capacity of the evacuation route. If the level of development in high hazard areas exceeds the route's capacity for safe and timely evacuation, the community can expect to suffer numerous casualties during a major storm. Local officials should bear in mind that the National Hurricane Center's hurricane warnings (usually used as the signal

to evacuate) are issued 12 hours before the eye is expected to hit land. Flooding and hurricane-strength winds can precede the landfall by several hours, depending on the storm's size and intensity.

If the community's evacuation time exceeds this standard warning time, the local government needs to take steps to either reduce the evacuation time or increase the warning time available. Reducing the evacuation time may entail (1) staging evacuation and controlling traffic better to ensure a smoother and earlier flow of traffic, (2) improving the capacity of the evacuation route, especially any bottlenecks, and/or (3) limiting the level of development in areas that will have to be evacuated. The local government may also want to take such steps as keeping denser developments closer to bridges and wider roads so they can be evacuated more quickly and avoid "squeezing through" narrower routes farther away from major roads.

IDENTIFYING AND RANKING MITIGATION PROBLEMS

The levels of effort devoted to particular hazard mitigation problems should be a function of both the severity of risk and the magnitude of risk present. During the inventories described above, certain issues or problem areas will begin to stand out from the rest by presenting a high severity of risk and/or a high magnitude of risk. Balancing the severity of risk and magnitude of risk in each hazard area will help the community rank its priorities for hazard mitigation by enabling it to identify the more important problems, address them first, and thus use local resources more effectively and efficiently.

The community should direct a greater level of effort in planning for hazard mitigation to an area with a high severity of risk and a high magnitude of risk (such as an ocean erodible AEC having a large number of structures not designed to withstand hurricane forces). Less effort will be called for in an area exhibiting a lower severity of risk and a lower magnitude of risk (such as part of an A-zone where little development exists or is expected to occur). Most of the problem areas a community identifies will fall between these two extremes. Some areas will have a high severity and low magnitude of risk; some areas will have a low severity and high magnitude of risk.

The assessments of risk severity and risk magnitude, and the balancing of the two, should culminate in a ranked list of hazard mitigation problems the community must address. This list of priorities will guide the community in its evaluation of current hazard mitigation measures and its evaluation of other mitigation options which could fulfill those needs not adequately addressed by existing local policies.

Determining an Acceptable Level of Risk

Deciding what kind of development the community will allow in each hazard area involves balancing the benefits of development with hazard mitigation against the benefits of development without hazard mitigation. Hazard mitigation does not necessarily seek to limit the total amount of development which

occurs in the community. It does seek to control the location and structural integrity of development in the community to ensure that any development within hazard areas is built to withstand the damaging forces of hurricanes and other major storms.

Conflicting demands for the use of scarce coastal land call for fair and well-reasoned local planning to guide the location and quality of development. The "locational benefit" concept is helpful in determining whether or not certain uses should be allowed in different hazard areas. The "locational benefit" concept is based on the fact that the benefits of some types of development can be retained regardless of where those activities locate in the community; therefore, the risk of hurricane damages can be reduced by channeling these activities away from high hazard areas. On the other hand, some activities have strong locational requirements (such as a waterfront site) that necessitate the use of hazard-prone land. In such cases, the benefits of locating in a high hazard area can outweigh the risk of damages. In all development management decisions, communities use this "locational benefit" test to determine which uses are inappropriate and discouraged in certain areas and which uses are appropriate and encouraged. Lists of "permitted uses" for different sections of a community are common; they appear in local zoning ordinances, state regulations for development in AECs, and National Flood Insurance Program guidelines.

Determining which activities are appropriate in each hazard area will depend on the level of risk existing in each area and the level of damage protection the community desires. Some communities will be able to sustain the same level of development and a lower level of risk by channeling certain activities away from hazardous areas. Some communities will be able to sustain the same level of development and a lower level of risk by enforcing stricter construction standards for activities permitted in hazardous areas. There are cases on the North Carolina coast, especially on the barrier islands, where the entire community falls within a flood hazard area (or A-zone) designated by the National Flood Insurance Program. As development continues in these communities, it must be built to withstand hurricane forces and reduce the risk of damages. Other communities will have tracts of land that do not fall in a high hazard area; these tracts will be able to safely sustain a greater level of development than will high hazard areas. Most communities are likely to use a combination of land use controls and construction requirements to permit certain uses and require certain building practices in each hazard area. Land use and construction guidelines must be in keeping with the severity of risk present in each hazard area.

The community must make value judgments to determine what levels of risk are acceptable and to decide what kinds of development are appropriate for each hazard area. Different people in the community will have different perceptions of what level of risk is acceptable. If the local planning process accounts for these different perceptions, the community can reach a consensus on what approach it should take to mitigate the hurricane hazard. However, the decision should not be purely subjective; it must be based on sound information on how hurricane forces affect the local landscape, accounting for past storm damages and the likelihood of future damages. Even though this information is not detailed and deterministic enough to say with absolute certainty which building will be washed away and which building won't, it does

provide a reasonable and defensible basis for the development and enforcement of land use and construction guidelines.

REVIEWING CURRENT MITIGATION MEASURES

Once the community has identified its key hurricane hazard problems, it must examine policies and programs that are currently in place to reduce the risk of future damages. This includes not only an identification of various local, state, and federal policies and programs, but also an assessment of how well they meet the goal of hazard mitigation. Existing policies, development standards, and enforcement procedures may already be meeting the community's hazard mitigation needs; even if these actions fall short, they may still be used as a basis for adopting new actions to reduce the risk of future hurricane damages.

An examination of existing policies will give the community a clearer understanding of any conflicts in policy within the local government and between the local government and state and federal agencies. It will also identify whether or not local government efforts at managing the location and quality of development are adequately addressing the specific mitigation needs identified previously.

Two types of shortcomings can exist in the ability of existing policies to meet the community's mitigation needs: problems in coverage and problems in enforcement. Problems in coverage arise when local policy fails to account for a particular characteristic of development, or a particular hurricane force (wind, waves, etc.), which increases development's risk of future hurricane damages. Problems in enforcement arise when local policy adequately covers a particular characteristic of development but, for some reason, is not carried out in the local government's day-to-day decisions and operations. Ideally, a community will have no problems in coverage or enforcement. Such a case is rare. The multitude of financial, political, and legal constraints under which local governments operate typically preclude ideal situations and complete protection from future damages.

Coverage Problems

Coverage problems arise due to a lack of information regarding a particular hazard (and how best to address it), other political or economic interests of the community overriding concern about the hazard, and a lack of coordination between local, state, and federal policies. Communities need to take stock of those local, state, and federal policies and actions that influence the location and quality of development and either increase or decrease the risk of damages. To reduce the risk of damages, a local government can then maintain or strengthen policies known to decrease risk and amend or avoid actions known to increase risk. Different policies will influence different characteristics of development and guard against different hazards. In order for development regulations to help reduce hurricane damages, they must:

1. recognize different areas in the community which face different levels of risk;

2. account for the different forces operating in these areas (high wind, flooding, wave action, and erosion); and

3. outline standards for development to follow in either avoiding hazardous locations or building to withstand hurricane forces.

The community needs to ask itself certain questions in reviewing its development policies to see if they adequately protect against hurricane damages. These questions appear in Table 5.1.

State and federal policies and programs can have a strong impact on development. Unfortunately, some communities fail to consider these effects in their local government operations and end up with a misguided or ineffective program for managing development. While it is not necessary for the local government to catalog every state and federal program that directly or indirectly influences land use or building construction, it should be aware of those programs that have major impacts on local development and that provide a context within which local actions operate to reduce the risk of hurricane damages. Some state and federal policies will complement or enhance local hazard mitigation efforts. Others might deter local efforts by stimulating unwise development, might approach the hurricane hazard from a different angle, or might ignore the hazard altogether. Individual policies can create an opportunity for local action or an obstacle for local efforts to overcome.

Federal programs which directly and indirectly affect the location and quality of local development fall into three categories: assistance programs, construction programs, and regulatory programs. At a minimum, most federal actions must, under the Coastal Zone Management Act of 1972, comply with the state's coastal area management program and the local plans adopted as part of it. This could give local hazard mitigation policies a good deal of leverage over federal agency actions. Federal actions must also comply with the procedures outlined in Executive Order 11988 — "Floodplain Management" — which calls for federal agencies to explicitly deal with flood hazards in their decision-making procedures.

Assistance programs provide financial and/or technical assistance for local development projects and local government operations. They run the gamut from community development block grants (CDBGs) to grants-in-aid and loans that individual agencies offer for constructing public facilities (roads, water and sewer plants, etc.), for improving housing conditions, and for assisting small businesses. Assistance programs include disaster relief aid programs, which have a profound impact on redevelopment following a disaster. They also include the National Flood Insurance Program, which most explicitly deals with flood hazards. The National Flood Insurance Program requires participating communities to take action to mitigate flood hazards; flood protection requirements in other assistance programs are less stringent, if they exist at all.

Table 5.1: Checklist for Reviewing Current Mitigation Measures

For development throughout the community:

- Do existing policies and regulations recognize the existence of different hazard areas that are subject to different forces?
- Do they cover all types of structures (single-family, multi-family, commercial, etc.)?
- Do they cover public facilities as well as private?
- Do they encourage higher-density uses to locate outside of the most hazardous areas?
- Are non-conforming uses and structures to be brought into conformity after they are damaged?
- Do existing policies and regulations relate the level of development in the community to the capacity of existing evacuation routes and the time it would take to evacuate the community?

For areas subject to high winds (Area 4):

- Do existing policies and regulations require structural connections and bracing adequate to withstand hurricane-force winds (or "annual extreme fastest wind speeds")?
- Do they require mobile homes to be tied down?

For areas also subject to flooding (Area 3):

- Do existing policies and regulations require buildings and utilities to be elevated or floodproofed to or above expected flood levels?
- Do they require structural connections which withstand the flotation and lateral movement of structures?

For areas also subject to wave action (Area 2):

- Do existing policies and regulations require buildings to be elevated to or above the expected wave height?
- Do they require structural connections and bracing adequate for the building to withstand battering by waves?
- Do the regulations prohibit building on fill which could easily be washed away?

For areas also subject to severe erosion (Area 1):

- Do existing policies and regulations require an adequate setback from the oceanfront or soundfront?
- Do they require a safe depth for embedding pilings?
- Do they prohibit the removal of sand dunes and other natural barriers to erosion?

In construction programs, federal agencies directly undertake construction of some facility. The facility could be a federal office building or an erosion control project. The acquisition of land and construction of recreational facilities for national seashores and wildlife refuges will also affect the character of development in the community.

Regulatory programs seek to control some aspect of development in order to achieve some national goal (such as navigability of waterways or environmental protection). These include the Corps of Engineers' Section 404 dredge and fill permits and the facility permits issued by EPA (or a designated state agency) under the Federal Water Pollution Control Act. Local officials should, based on their experience, be able to recognize other regulatory programs that influence development in the community. Construction and regulatory programs, like assistance programs, will vary in the attention they give to the hurricane hazard.

The same patterns hold true for state programs, the effects of which are usually broader, stronger, and more direct. As with federal programs, state programs which affect the location and quality of development fall into three basic categories: regulatory, construction, and assistance. Since the state has greater power and responsibility than the federal government for controlling the impacts of development and for providing public services, state programs are geared more heavily toward regulation and construction.

The state regulatory program in North Carolina which most strongly influences coastal development and most directly addresses the hurricane hazard is that instituted by the Coastal Area Management Act, especially CAMA's AEC regulations and coastal construction standards. The State Building Code has a direct bearing on the quality of construction in the community. Other permit programs (for pollution discharges, dredge and fill, etc.) administered by the Division of Environmental Management, the Office of Coastal Management, and other agencies can also affect the character of development.

State construction projects, such as roads and bridges built by the N.C. Department of Transportation, can have a strong influence on the location of development, either channeling it into or away from hazard areas. The acquisition of land for state parks and the construction of recreation facilities can also influence the overall character of a community and the use of hazardous lands.

Local officials should be able to (1) identify those state and federal programs with major impacts on development in hurricane hazard areas and (2) identify the specific characteristics of development (location, structural integrity, etc.) that each program affects. While federal and state programs can always change, local officials should remain aware of their influence and keep track of any relevant shifts in federal and state policy. Even though the community may not be able to change the focus of state and federal programs, it can adjust its planning and operations to account for the impact of federal and state programs.

The community may find that existing federal and state programs reinforce local policies regarding the hurricane hazard. In fact, federal and state regulatory programs may prove adequate in and of themselves to reduce the risk of hurricane damages by controlling a characteristic of development that is of

particular local concern. This could eliminate the need for direct local action and help the community avoid duplicative regulation. The community could then channel its hazard mitigation efforts to those aspects of development which are not covered by state and federal programs. The examination of state and federal policies might also point out conflicts with local policy that could hinder the community's hazard mitigation efforts and would need to be overcome.

Local policies exert the most direct control over development in hazardous areas. In addition to identifying state and federal policies, the community must identify and assess how its own policies affect development in hazard areas. Local policies include regulatory programs and construction programs. Regulatory programs include zoning and subdivision ordinances, building codes, environmental protection ordinances (covering sand dunes, septic tanks, etc.), and procedures for permitting "minor" projects in designated AECs. Construction programs include all capital improvements decisions (public buildings, recreation facilities, and utility systems). The analysis should include the specific characteristics of development and the specific areas of the community that each policy covers.

After comparing the community's hazard mitigation needs to the characteristics of development covered by local, state, and federal policies, the local government can identify any shortcomings in coverage that could be resolved by amending existing policies and/or adopting new ones. The community can also identify any needless duplication of policies or planning efforts, where two or more existing programs deal with the same characteristic of development.

Throughout its examination of existing policies, the local government must bear in mind that the intended effect of a policy may not match its actual effect on development within hazard areas. Local governments want tools that work the way they are supposed to; local officials should therefore pay attention to the actual effects of public policy. Disparity between the actual and intended effects of a local policy can spring from (1) incorrect base data regarding the characteristics of development, (2) the measure's inadequacy in covering a particular characteristic of development, or (3) poor enforcement of the policy.

Enforcement Problems

The adoption of a policy to manage development in a certain way does not necessarily mean that the policy will be implemented effectively. Even though local policies may cover all the characteristics of development creating a hurricane hazard, problems in enforcing these policies may keep the community in serious danger of future damages. Local land use plans and other planning documents are formal declarations of policies for managing development; however, meeting their policy objectives usually requires formulating standards for development that have the force of law. These standards are the guide for local permit-letting activities, local government construction projects, and other local government decisions. Zoning ordinances, subdivision regulations, building codes, and other permit requirements enact the standards needed to carry out local development policies. Enforcement procedures are just as important as the standards themselves and should not be

overlooked in reviewing the community's current system of managing development. How the standards are applied or carried out in the local government's day-to-day operations has a direct bearing on the effectiveness of local policies at reducing the community's potential for storm damages.

Enforcement problems can crop up for a number of reasons. First, the community may simply lack a set of standards or prescribed actions for carrying out a policy. Second, existing standards may be too complex and hard to understand, thus obstructing timely and efficient permit decisions and other local government actions. Third, the local government may not be allocating or may not have enough staff time, technical skills, and finances to administer the standards. Fourth, political and economic pressures in the community may be causing the local government to allow a large number of variances from the standards. All of the above could indicate that the community needs to pursue another approach (either adopting a different procedure or standard or amending the existing ones) or that it needs to devote more attention and resources to administering development standards.

The community's overall assessment of existing development policies, by comparing them to the characteristics of development it needs to control, should point out improvements in both coverage and enforcement that are needed to protect the community from future hurricane damages. The analysis may point out needless duplications as well as shortcomings. If existing policies and enforcement procedures are inadequate for protecting the community from the hurricane hazard, then modifications may be in order. These modifications could involve amending existing policies and procedures or adopting new ones.

REVIEWING ALTERNATIVE MEASURES

To overcome any shortcomings in the coverage or enforcement of existing policies, the community will need to review other techniques that could be used effectively and efficiently to reduce the risk of future hurricane damages. Different techniques are suited to different development and redevelopment problems; certain techniques will be more practical and more effective than others in addressing the community's particular hazard mitigation needs.

The first step of this review should be a comparison of the characteristics of development or reconstruction the community needs to control to the different mitigation tools and programs described in Chapter 4. This comparison should produce a list of alternative measures meriting further examination by the community. For example, if the community's main concern is the quality of construction in hurricane hazard areas, then it might want to look at what different construction methods and standards are available. If the community's main concern is the location of new development within hazard areas, then it might consider a variety of land use controls. If the community's main concern is the reconstruction of buildings after a hurricane, then it might want to look at different relocation programs, land use controls, and construction standards.

After identifying the basic categories of techniques applicable to local hazard conditions, the community should undertake a more thorough evaluation

of individual techniques to see which ones are most practical, given local conditions, and which ones could be refined to suit local needs. Unfamiliarity with a particular tool or technique should not automatically exclude it from consideration; the community might come up with a variation of the technique which quite effectively addresses local hurricane problems.

The local government should pursue techniques which are targeted toward the particular characteristics of development creating a hazard, which are palatable or acceptable to the general community, which are within the realm of local authority, and which are within local administrative capabilities. Each technique the community considers should be evaluated with respect to five factors:

1. the community's development situation (that is, the conditions which need to be modified to reduce the risk of hurricane damages);

2. the technical and administrative expertise available;

3. the availability of fiscal resources to administer the measure;

4. the local political situation (that is, local attitudes toward planning and development controls); and,

5. the legal status of the technique.

Understanding the community's development situation is necessary for selecting any tools to influence the pattern and quality of development. The analysis performed up to this point should give the community a strong idea of the specific conditions which it needs to modify. Different measures are better suited to controlling different characteristics of development. Some influence the location of private development and public works; some influence the quality of construction. The community should use tools that will directly influence the conditions it wants to maintain or change.

Each tool will require a certain level of technical and administrative capability. Measures that require extensive planning studies and monitoring systems may not be practical for a small community which lacks the necessary technical support, unless the community can obtain technical assistance from state and federal agencies. By the same token, measures that involve complicated or lengthy permit and appeal procedures may not be practical for a community which uses part-time inspectors and citizen boards to regulate development. Simple procedures, based on clear development standards that can be easily understood and administered by existing personnel, should be a key element in any community's effort to reduce the risk of hurricane damages. The community needs to assess what it can and cannot do with its current staff and, therefore, look for tools that are suited to its current administrative capabilities. Selecting a measure that requires more personnel and financial resources will require outside assistance or a greater financial commitment for local programs that manage development.

The cost of using a particular tool is closely related to the technical and administrative resources needed by the community. Some tools may require hiring full-time inspectors and other personnel. Some tools may require a

reserve of public funds to relocate buildings, roads, and public utility lines. While state and federal aid may be available to help offset costs, instituting a particular measure could require a shift in local budget priorities. In any case, the local government needs to weigh any tools under consideration against its ability to finance their administration.

Local attitudes toward planning and development controls can render certain tools politically unacceptable. Many local residents will see any attempt to manage development as a threat to private property rights. These feelings may intensify as the local government introduces new or complicated techniques which residents do not understand. Increasing local taxes to cover the costs of administering a development regulation can also render it unacceptable. The local government can overcome some of these problems by getting citizens involved in the selection and adoption of different tools and by ensuring that a variety of local interests are represented in the local government's decision to pursue a particular measure. Even though the community as a whole may welcome the adoption of a particular tool, different interest groups can hamper its effectiveness by pressuring local decision makers (local commissioners, planning board members, etc.) to grant variances and otherwise skirt development standards. In adopting any technique, the local government needs to strike a balance between what will be politically acceptable and what will do an effective job at reducing hurricane risks.

A tool's political acceptability is closely related to its legal status. Some tools will have clear authority under current enabling legislation; the authority for others will be less certain. Even though a community must sometimes be innovative to deal with a unique problem, it is wise to stick to techniques that have clearer authority and have been used successfully elsewhere. (Chapter 4 discusses the authority underlying different measures and ways they have been used in communities throughout the country.) It is also wise to stick to techniques that fall within the framework of existing state and federal programs dealing with hurricane hazards (such as CAMA, the N.C. State Building Code, and the National Flood Insurance Program), each of which leaves room for more stringent local standards and has a sound legal footing. As the state adopts new enabling legislation and as different tools withstand court challenges, the range of options open to local governments will expand. Legal challenges can arise regarding both substantive issues (that is, what a tool does or controls) and procedural issues (that is, how the local government applies the tool in its day-to-day operations). While the mere possibility of legal challenges should not automatically keep the community from considering certain tools, the community should be aware of the legal issues involved in adopting and administering any tool for managing development.

After comparing the above factors to the different measures available, the local government must balance a number of constraints in choosing which tools to use. Ideally, the measures selected will be legally defensible, politically acceptable, and compatible with local administrative, technical, and financial capabilities. In pursuing any particular measure, the community will probably have to undergo an adjustment in current politics or administrative procedures to work the measure into its existing program for managing development. The magnitude of this adjustment will depend on how the tool compares to local political, administrative, and fiscal conditions.

At this point in the process, the community should have several products. First is a list of hurricane hazard mitigation needs or development characteristics the community needs to control. Second is a compilation of measures which are currently in place to mitigate the hurricane hazard. Third is a compilation of measures which the community can adopt to cover any needs that current measures fail to address. The next step in the process involves blending these into a coordinated local program for reducing the risk of hurricane damages.

IMPLEMENTATION AND MONITORING

Implementation of local policies is the final step in formulating a hazard mitigation program, as it is with any good planning effort. Once local policies are implemented and hazard reduction measures are being carried out, the community needs to monitor development to ensure that prescribed measures are being followed.

Implementation involves adopting those policies and ordinances necessary to put hazard mitigation measures into effect. The selection of different hazard mitigation measures should be based on an analysis of the community's susceptibility to storm damages (Steps A and B), an identification of key mitigation problems (Step C), and an analysis of local measures that address these problems (Steps D and E).

Certain policies will put hazard mitigation measures into continuous operation as a means of managing development in the community, such as zoning requirements and construction standards. Other policies will put hazard mitigation measures into effect only in response to disaster, such as relocation programs and temporary moratoria on development and reconstruction. All policies which guide development and reconstruction should recognize the different levels of risk that exist in different parts of the community and in different types of structures.

These policies should be adopted and in force before a disaster actually occurs in the community. This allows the community to formulate and enact different ordinances and programs in a more rational manner, rather than responding to problems and trying to resolve them at the "heat of the moment" immediately after disaster strikes. Such advance planning gives the community time to examine storm hazards and formulate workable and effective means of mitigating them. It also gives the community time to follow normal administrative procedures in adopting new policies and to include full public participation in local government decision making. This time does not exist after disaster strikes; people begin rebuilding immediately and tend not to protect themselves against future damages by relocating or building more strongly unless local policies guide them to do so. Local efforts to adopt hazard mitigation measures immediately after a disaster run headlong into this rush to rebuild; in 1982, Gulf Shores, Alabama, adopted a strong zoning ordinance in response to Hurricane Frederic (which occurred in 1979), but only after 80 percent of the community was already rebuilt. Communities need to plan carefully and adopt appropriate hazard mitigation measures ahead of time so that post-disaster reconstruction follows prescribed guidelines to adequately reduce the risk of future damages.

Implementing hazard mitigation measures before disaster strikes also ensures that development taking place now is reasonably safe from storm damages. There is little sense in waiting for a disaster to occur when a community can take steps beforehand to reduce the impact of a disaster and to save the community a good deal of money and emotional stress. The lack of time for good planning after a hurricane or other disaster further points out the need for good planning before disaster strikes. Reducing the risk of future damages from hurricanes and other major storms should be a primary goal of a vulnerable coastal community; measures to mitigate these damages should be a primary element of the community's regular planning and decision-making procedures.

Local hurricane hazard mitigation measures need to be integrated with other local plans, policies, and programs which cover other aspects of development in the community. Local officials need to bear in mind how hazard mitigation relates to other goals and policies of the community. For example, local land use policies may advocate a level or density of development that exceeds the community's capacity for safe and timely evacuation. Local policies that regulate development to reduce the risk of hurricane damages can help local emergency operations plans be carried out smoothly by reducing the overall level of damage in the community. Hazard mitigation policies governing the location and design of public facilities directly affect local capital improvement planning. Land acquisition programs can affect local planning for beach access and other open space uses. Hazard mitigation planning should consider how various hazard mitigation, land use, emergency operations, capital improvements, beach access, and other plans and policies affect each other. It should also consider how local hazard mitigation policies and programs relate to state and federal programs which help manage development and reconstruction in the community and help reduce the risk of storm damages.

The local government should continuously observe how development is proceeding in the community once hazard mitigation measures are adopted and implemented. Keeping track of development helps the community see if hazard mitigation policies are being followed and if hazard mitigation policies need to be modified in any way to make them more workable and effective. Such monitoring can identify further problems in coverage and enforcement that the community needs to resolve. Monitoring efforts can involve less formal, continuous observations or more formal, periodic evaluations. In whatever form, monitoring efforts should pay attention to where development is locating (relative to different hazard areas) and how development is being built (relative to the forces expected in each hazard area).

REFERENCES: CHAPTER 5

Dames and Moore, Inc. 1981. Design and Construction Manual for Residential Buildings in Coastal High Hazard Areas. Washington, DC: Federal Emergency Management Agency (Report No. FIA-7).

Stone, John R. 1982 (forthcoming). Hurricane Emergency Planning: Estimating Evacuation Times for Non-metropolitan Coastal Communities. Raleigh, NC: UNC Sea Grant College Program.

CHAPTER 6:

TOPSAIL ISLAND CASE STUDY

A case study conducted on Topsail Island, North Carolina, illustrates the hurricane hazards present in coastal communities and the ways local government can manage development to mitigate these hazards. The case study applies the process outlined in the preceding chapter to map hazard areas, assess the community's vulnerability to damage, identify mitigation needs, and review mitigation measures. The case study demonstrates some of the issues facing a community which is trying to manage development to reduce the risk of hurricane damages. It also points out the need for coastal communities to plan for reconstruction before the storm to minimize the chaos that attends any natural disaster, to facilitate reconstruction, and to ensure that reconstruction leaves the community safer from the next storm.

Topsail Island is a coastal barrier located midway between Cape Lookout and Cape Fear (see Figure 6.1). The island is about 26 miles long and runs northeast to southwest. It is bounded on the south by the Atlantic Ocean, on the north by the Intracoastal Waterway, on the east by New River Inlet, and on the west by New Topsail Inlet. The eastern half of the island lies in Onslow County; this section is known as West Onslow Beach and is unincorporated. The western half of the island lies in Pender County and is divided between the Town of Surf City and the Town of Topsail Beach (see Figure 6.2). The island has a year-round population of about 820 and a peak seasonal (summer) population of about 19,950 (1980 estimates). The island is connected to the mainland by two two-lane bridges. A swing bridge built in the 1950s runs from Surf City across the Intracoastal Waterway. A newer and higher bridge runs from West Onslow Beach across the Intracoastal Waterway. A two-lane main road (N.C. 50 and 210) runs the length of the island, with side roads and parallel roads in the more developed areas (such as Surf City and Topsail Beach).

The island has been called Topsail Island since the 1700s. According to local legend, the name originated during the years when pirates hid their ships in the back channels and waited to attack passing merchant ships. After the merchant ships became aware of this hiding place, they began to watch for the topsails of the pirate ships showing over the dunes -- hence the island's name. During World War Two, the federal government possessed the island as part of nearby Camp Davis and installed a pontoon bridge, roads, power lines, and buildings. The government also built concrete towers and launch pads as the initial location for its Missile Launching Project, which was later moved to Cape Canaveral, Florida. In 1949, the island returned to private hands and began to develop as an ocean resort. Surf City incorporated in 1951. Topsail Beach incorporated in 1963.

Figure 6.1: Location of Topsail Island, North Carolina

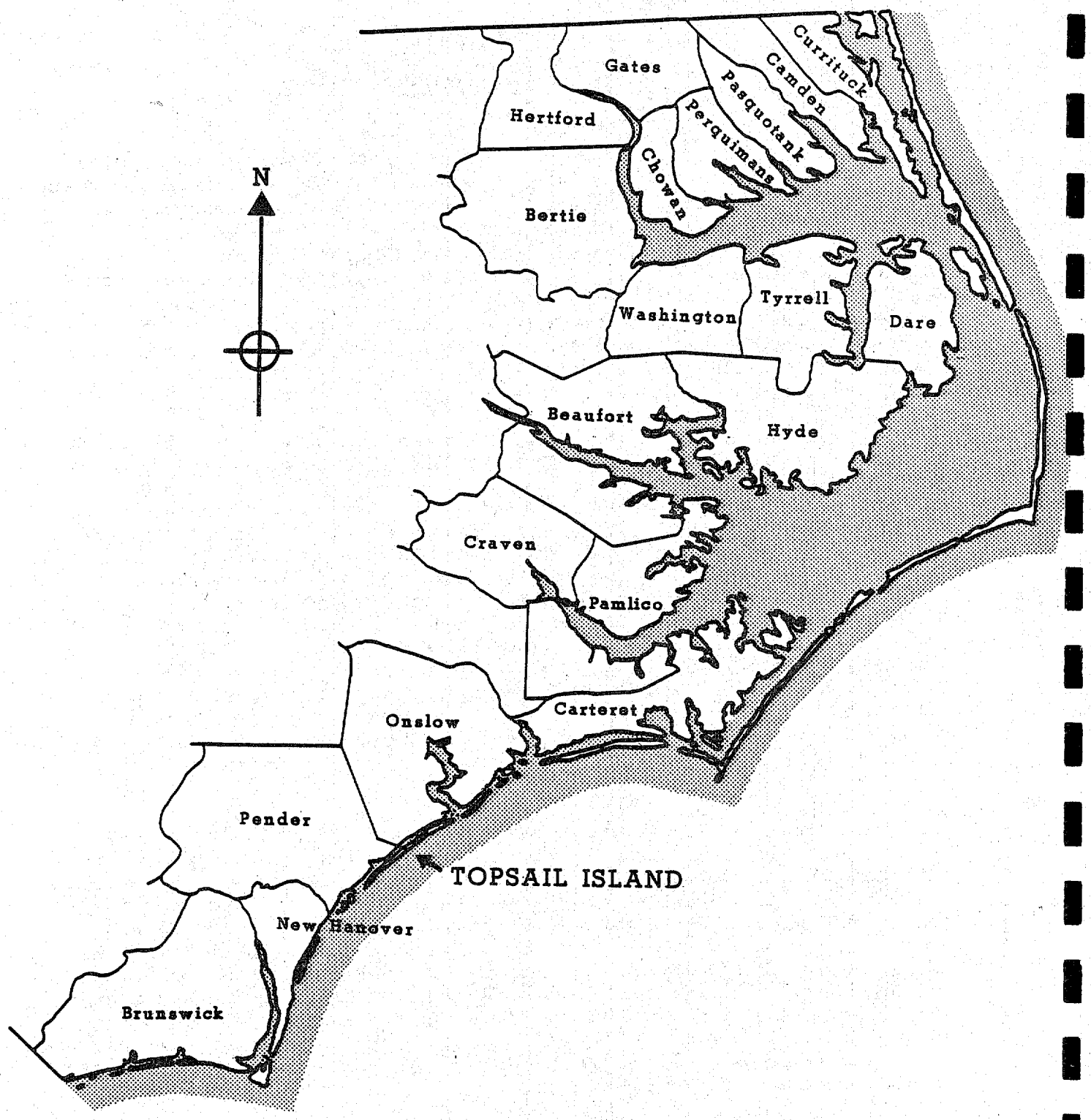
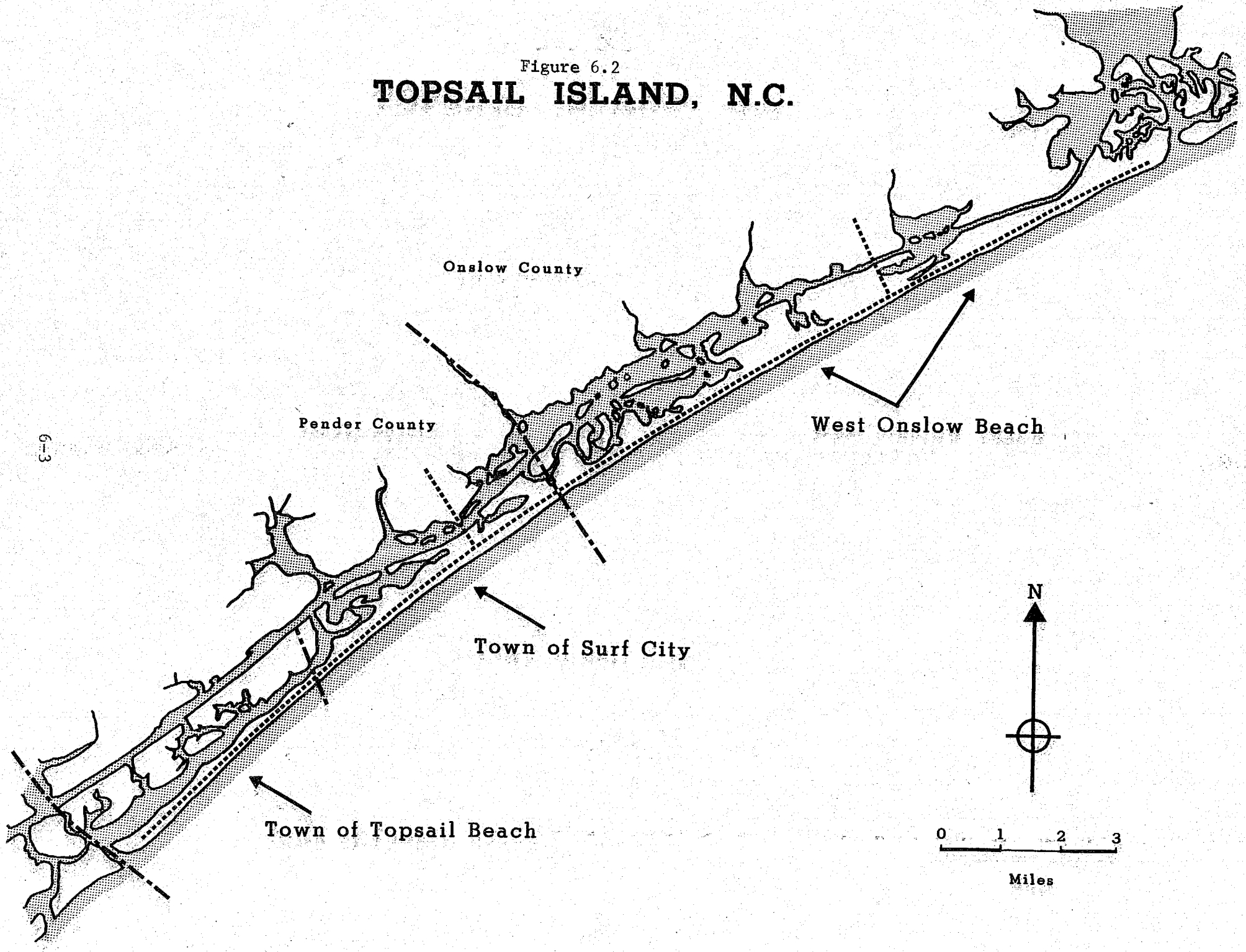


Figure 6.2

TOPSAIL ISLAND, N.C.



MAPPING HAZARD AREAS

Topsail Island contains the full array of hurricane hazard areas identified in the preceding chapter. Its vulnerability to damages from scour, wave action, flooding, and high winds differs at different sections of the island. The entire ocean shoreline is characterized by a beach and dune system which acts as a buffer to absorb the forces of the sea but is also very fragile. The beach along Topsail Island is gradually eroding inland, at a rate averaging about two to three feet per year. The inlets at each end of the island are also highly dynamic and bordered by low-lying land with little dune protection. Most of the island is less than ten feet above mean sea level, with higher elevations occurring mainly in Surf City and West Onslow Beach. The 100-year flood level, as determined by the Federal Insurance Administration, is roughly 13 feet above mean sea level. The island also contains some overwash fans, where past storms have breached the dunes and flattened the land behind them. The island also has three sets of finger canals, one very close to New Topsail Inlet, which create weak points in the island's resistance to hurricane forces. The island's estuarine shoreline is low-lying and mainly left in its natural state, though there is extensive bulkheading in Topsail Beach and along the finger canals, where homes have been built along the sound shore.

Several sources of information were used to map hazard areas on Topsail Island: the Coastal Resources Commission's AEC designations, the National Flood Insurance Program's rate maps and flood hazard boundary maps, and aerial photographs which identified overwash fans and finger canals. This information was combined into a Composite Hazard Map showing the different hazard areas and the level of risk associated with each.

National Flood Insurance Program Information

As participants in the Regular Phase of the National Flood Insurance Program, the Towns of Topsail Beach and Surf City had detailed flood insurance rate maps available; these identified A-zones (subject to flooding by the 100-year flood) and V-zones (subject to flooding plus wave action) in each town (see Figure 6.4). They also identified the relatively safer B-zones (subject to flooding by the 500-year flood) and C-zones (land above the 500-year flood elevation). Elevations in Topsail Beach and Surf City are generally less than ten feet above mean sea level. However, the flood insurance studies for Topsail Beach and Surf City determine the 100-year flood elevation to be 12.6 feet.

Because of Topsail Beach's uniformly low elevation and the low height of the frontal dunes along its beachfront, approximately 95 percent of the town's land area is in the V-zone, subject to flooding and wave action by the 100-year storm. The remaining five percent of the town is in the A-zone. The entire town can expect to be inundated by a major hurricane.

Surf City has a higher and more developed dune system and a more extensive soundside marsh. Thus only about fifty percent of the land in Surf City falls into the V-zone. Another forty percent falls into the A-zone. Only about ten percent of the land area is in the B and C-zones.

Onslow County is enrolled in the Emergency Phase of the National Flood Insurance Program; therefore, no detailed flood insurance rate maps are available for West Onslow Beach, only the less-detailed flood hazard boundary maps. These maps show only the "special flood hazard area" (also called Zone A) which is subject to flooding by the 100-year flood; they do not break this area down into A-zones and V-zones (see Figure 6.4). Such a breakdown will occur when the Federal Insurance Administration prepares its final flood insurance study for Onslow County and issues flood insurance rate maps. The flood hazard boundary maps for West Onslow Beach show the "special flood hazard area" as covering over 90 percent of the land in West Onslow Beach.

CAMA Information

The next step involved mapping the four areas of environmental concern addressing hurricane hazards: ocean erodible AECs, inlet hazard AECs, flood hazard AECs, and the estuarine shoreline AECs (see Figure 6.5). The Office of Coastal Management in Raleigh maintains aerial photographs demarcating ocean hazard AECs (ocean erodible areas, inlet hazard areas, and flood hazard areas). The flood hazard areas correspond to the National Flood Insurance Program's V-zones (but only those V-zones bordering the ocean). Estuarine shoreline AECs are set by Coastal Resources Commission regulations as all land within 75 feet of an estuarine shoreline. Ocean erodible areas, inlet hazard areas, and estuarine shorelines are subject to the full complement of hurricane hazards (erosion, wave action, flooding, and high winds). Flood hazard areas are subject to essentially the same hazards, but with less potential for serious erosion.

The ocean erodible AEC is based on a setback from the first line of stable natural vegetation plus an additional area where erosion can be expected from storm surges and wave action during the 100-year storm. The setback is determined by multiplying the annual erosion rate for a particular section of beach by 30; the setback on Topsail Island ranges from 60 to 76 feet for different segments of the beach. The total ocean erodible AEC for Topsail Island, as designated by the Office of Coastal Management, encompasses a strip ranging in width from 195 feet in the center of the island (Surf City) to 215 feet at the western end (Topsail Beach) and 286 feet at the eastern end (West Onslow Beach).

Topsail Island also contains two inlet hazard AECs, bordering New River Inlet and New Topsail Inlet. Each of these inlets is very dynamic, subject to large-scale shifts. New River Inlet is presently migrating southwest, causing erosion at the eastern end of the island at a rate of about 20 feet per year (Onslow County Planning Department, 1981, p. 33). New Topsail Inlet is also migrating to the southwest, gaining land for Topsail Beach. Inlets, however, are very unstable formations. Changes in the direction of migration are not unknown; hence, the generous setbacks used in the inlet hazard AECs.

An historical analysis of the geologic history of New Topsail Inlet indicates a very unstable past. A compilation of historical charts, maps, aerial photographs and geomorphic features shows that Topsail Island has grown at the southern end by almost 5 miles in the past 250 years as the inlet has migrated. This means that most of the town of Topsail Beach is on recently formed land.

The land contained in the inlet hazard areas is low-lying, with little or no dune protection. In a major storm, these areas will be washed over by water entering and leaving the sounds behind the island. The inlet hazard area bordering New Topsail Inlet also covers a set of three finger canals, which are cut so far into the island that they are separated from the ocean by only a two-lane road and a narrow strip of duneless beach.

Information from Aerial Photographs

The Office of Coastal Management's aerial photographs showed other hazardous areas which are not designated as AECs and are not directly addressed by flood insurance studies, namely overwash fans and finger canals. Overwash fans can be easily identified from aerial photographs by a breach in the dune system and an area of little or no vegetation which spreads inward from the beach. Several such areas were found on Topsail Island. Since these areas have low elevations, they are covered by the flood insurance maps as either A-zones or V-zones. However, the lack of dune protection makes these areas particularly vulnerable to future damage.

The aerial photographs also clearly showed the location and extent of finger canals on Topsail Island. Finger canals are artifically dredged areas, with housing typically placed on the narrow strips of land between them. Finger canals weaken a barrier island's resistance to erosion in a storm. Finger canals create weak spots which can easily become new inlets during major storms, as water that has collected in the sound funnels and pushes through the canals to the ocean. The danger is greater the deeper canals cut into an island and the less distance there is between the canals and the ocean. This recently happened in a normal winter storm with the finger canals near New Topsail Inlet, where water washed across the road to connect one of the canals to the ocean. While this washover was temporary, it points out the dangers that a larger storm will present. The land in this section of Topsail Island is low and without dunes or anything else that would prevent a breach.

Composite Hazard Map

The information from the flood insurance maps, AEC designations, and aerial photographs was integrated into a single Composite Hazard Map in order that all hazard areas could be identified together (see Figure 6.6). This compilation led to the designation of four general hazard areas, each with a different level of risk from the damaging forces of a hurricane. As shown in Table 6.1, Area 1 consists of the ocean erodible AECs, inlet hazard AECs, and estuarine shoreline AECs, each of which is subject to erosion, wave action, flooding, and high winds during a major storm. Area 2 consists of the flood insurance V-zones, which are subject to wave action, flooding, and high winds. Area 3 consists of the flood insurance A-zones, which are subject to flooding and high winds. Area 4 covers the rest of Topsail Island, which would still be subject to high winds during a hurricane though not likely to suffer flooding, wave action, or erosion. The Composite Hazard Map also pinpoints finger canals and overwash fans on the island as locations that are particularly hazardous for development; each of these is covered by one of the hazard areas listed above, but each still must be kept in mind in seeing how development on the island is or is not protected against hurricane damages.

Figure 6.3

INDEX TO HAZARD AREA MAPS

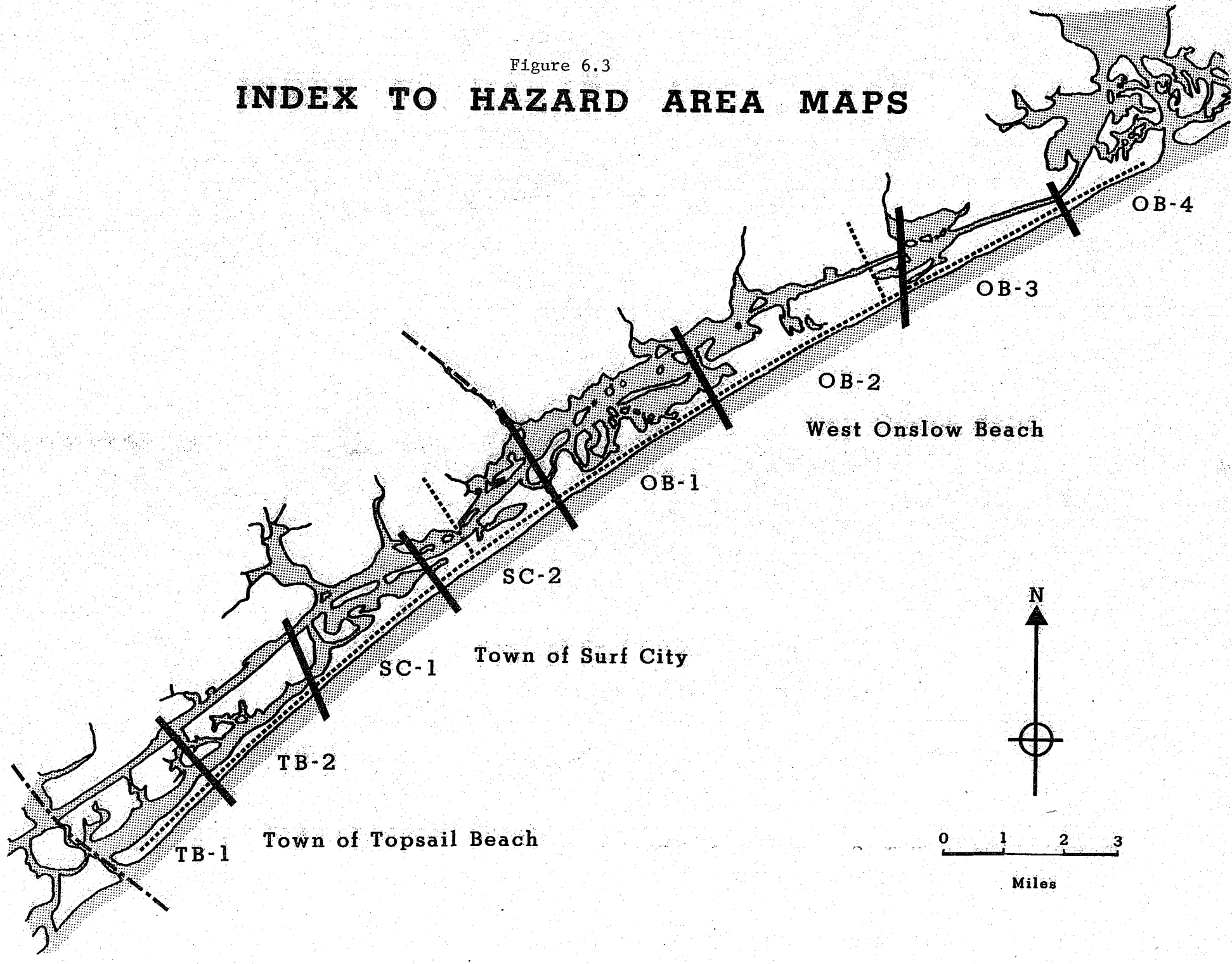


Figure 6.4

FLOOD INSURANCE ZONES

TOWN OF TOPSAIL BEACH

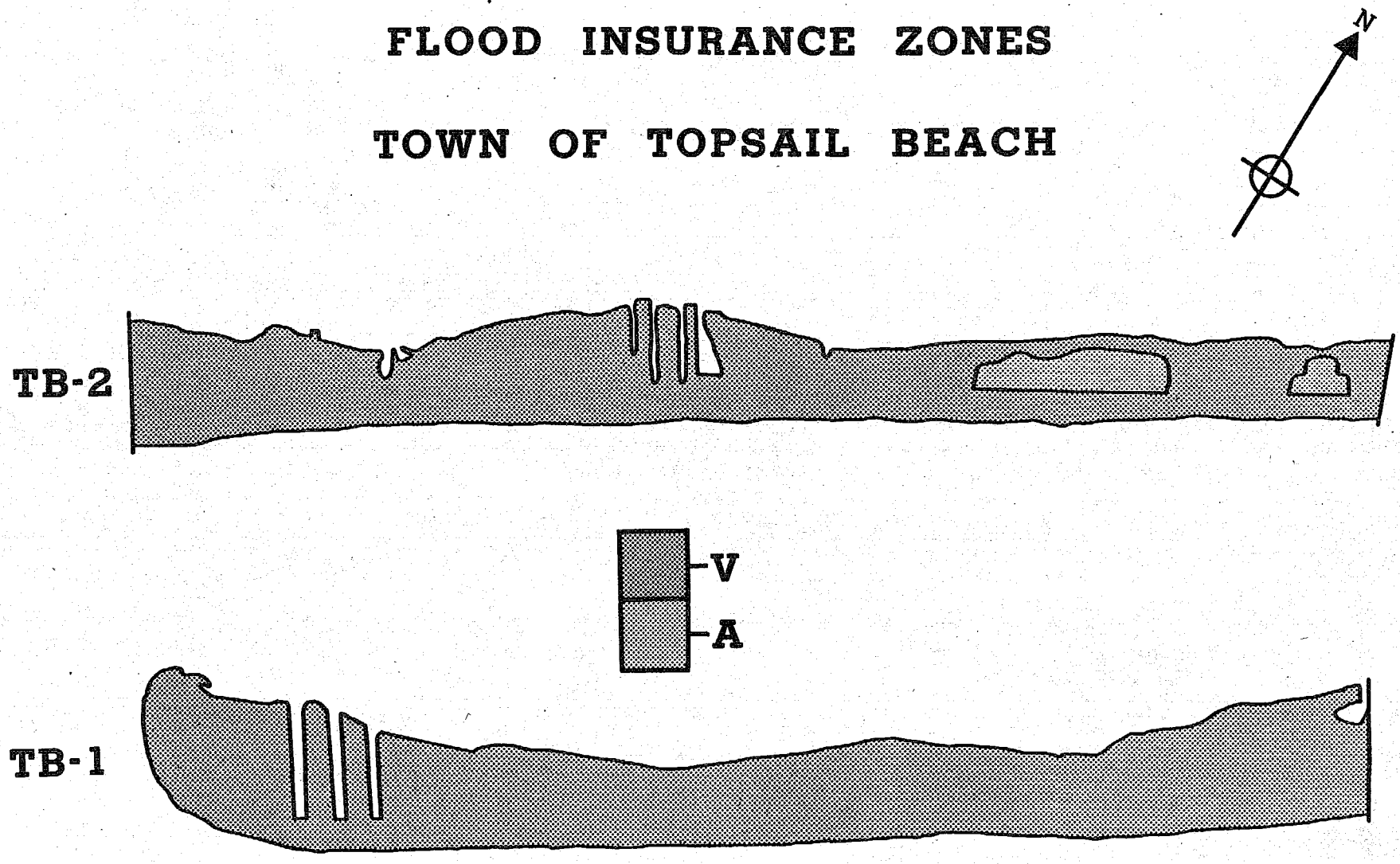


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Figure 6.4

FLOOD INSURANCE ZONES

TOWN OF SURF CITY

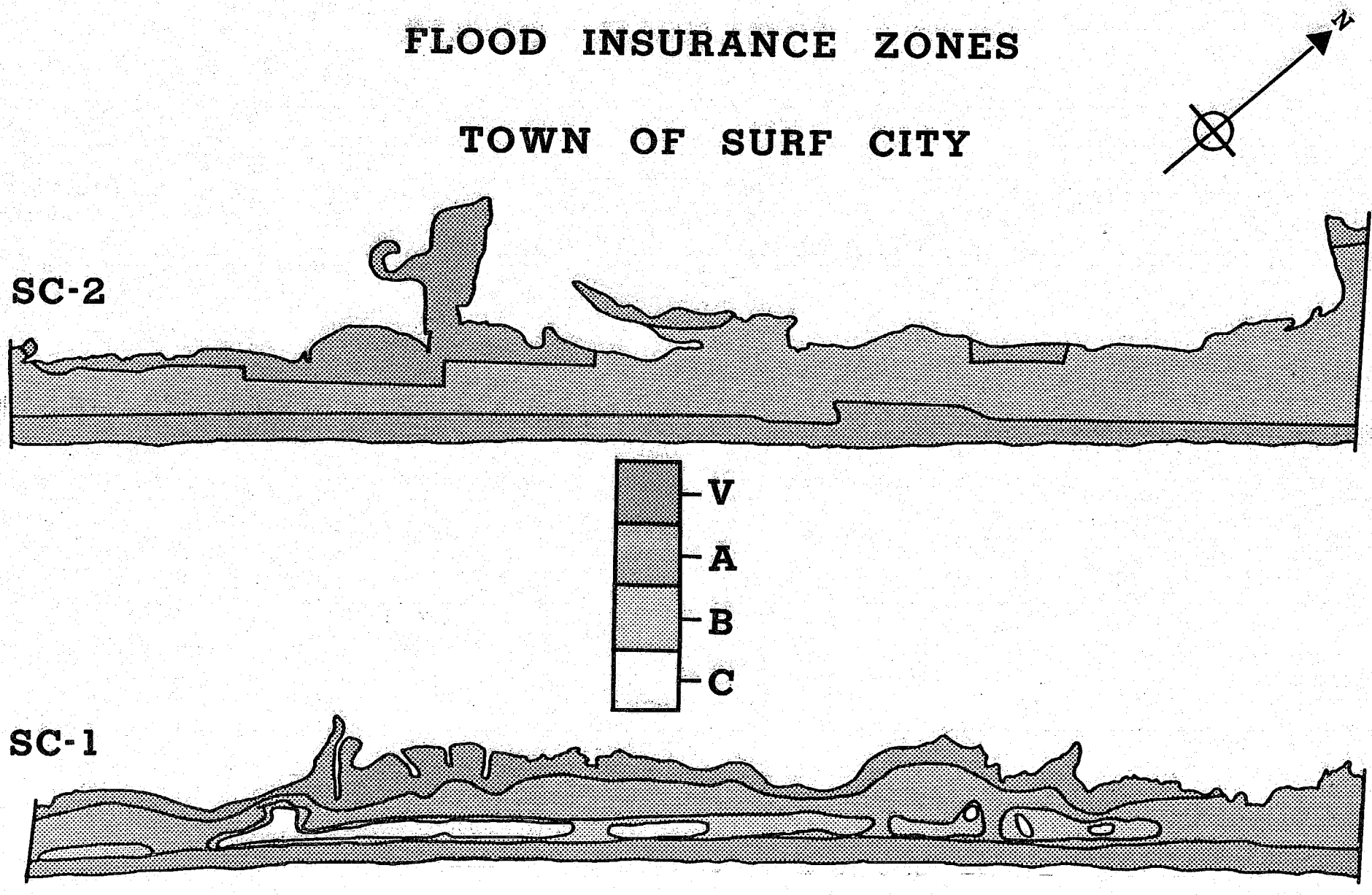

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Figure 6.4

FLOOD INSURANCE ZONES

WEST ONSLOW BEACH

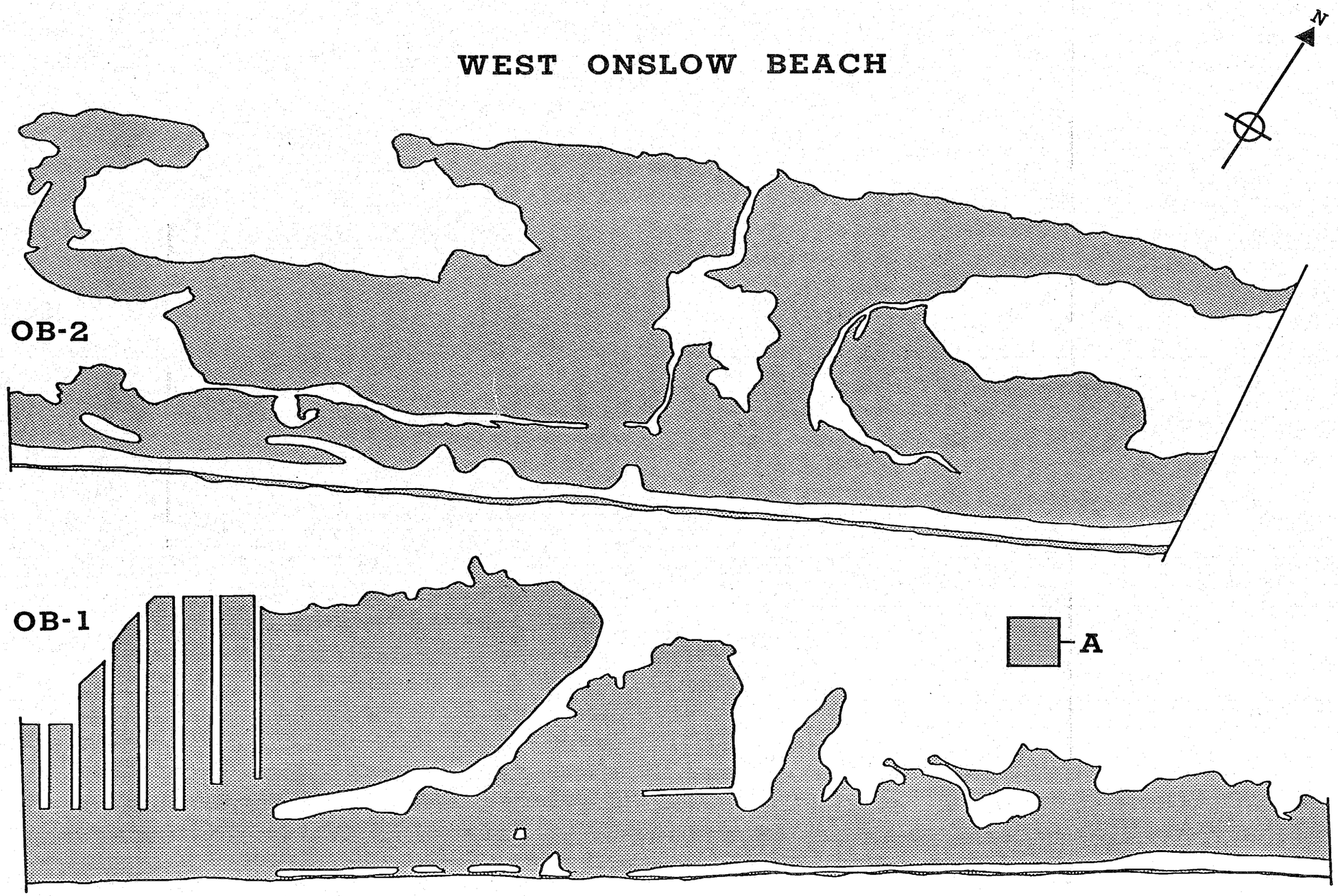

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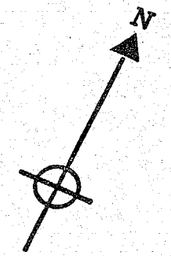
Figure 6.4

FLOOD INSURANCE ZONES

WEST ONSLOW BEACH



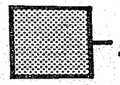


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Figure 6.5

CAMA AEC MAP

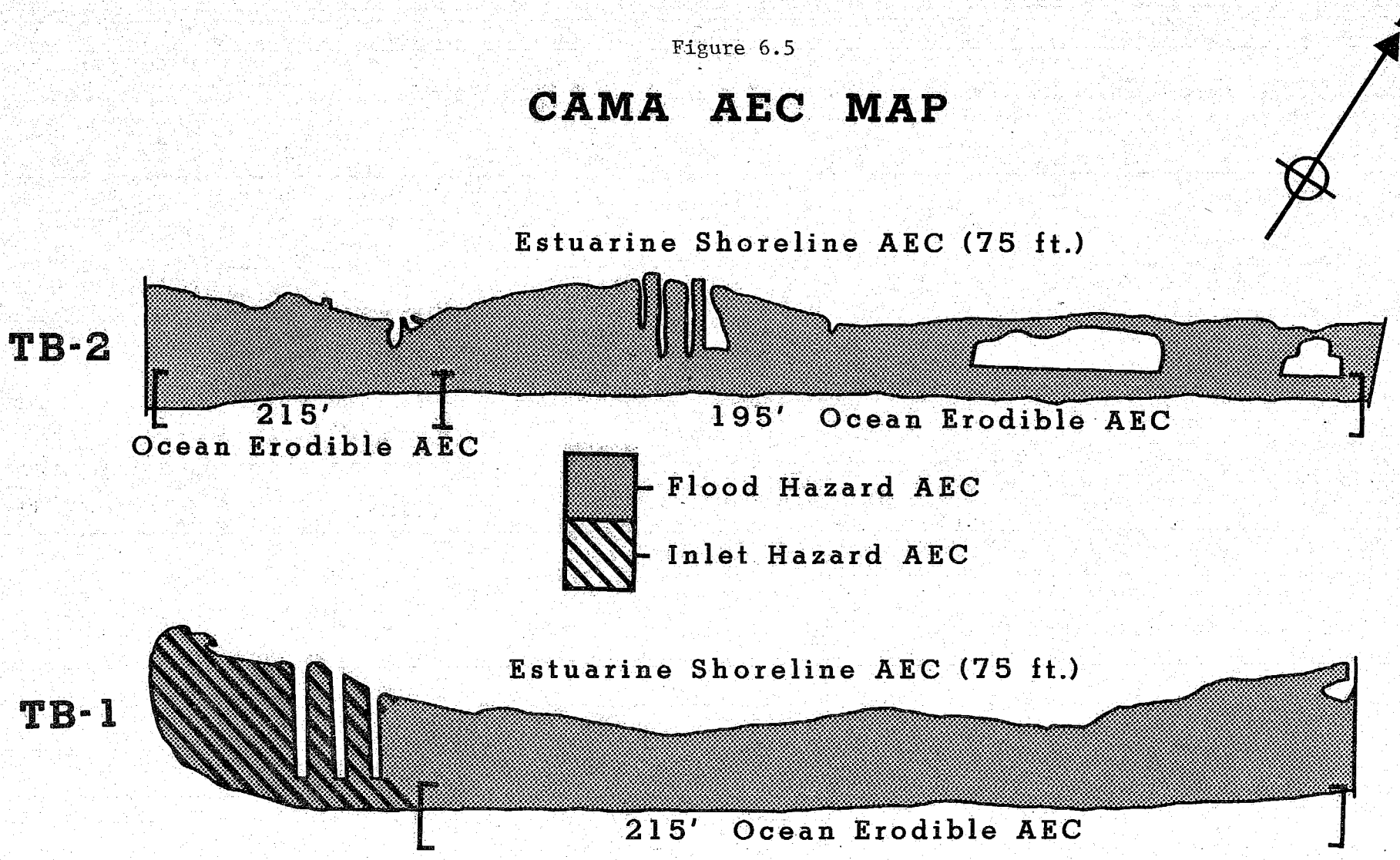

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Figure 6.5

CAMA AEC MAP

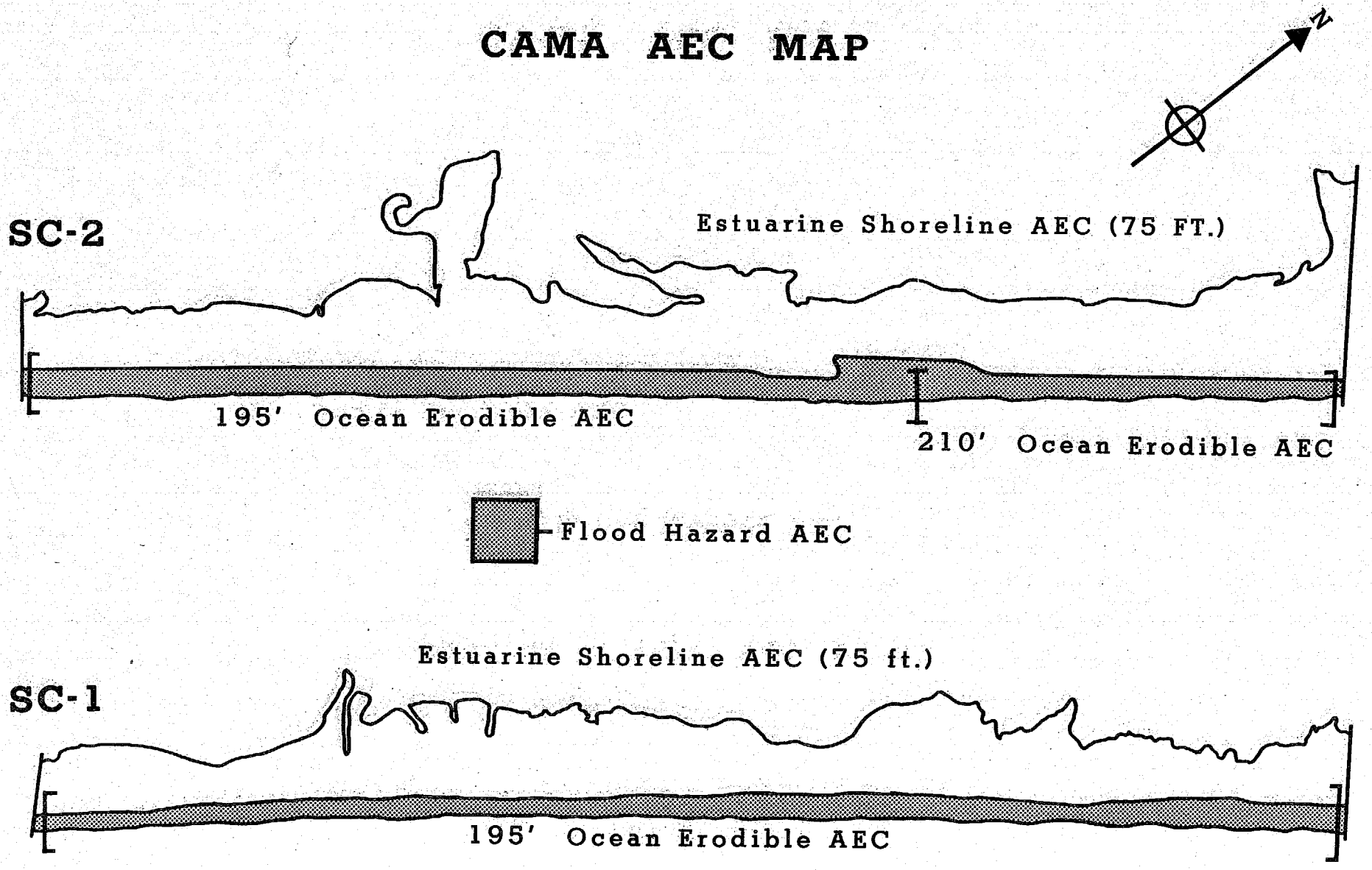

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Figure 6.5

CAMA AEC MAP

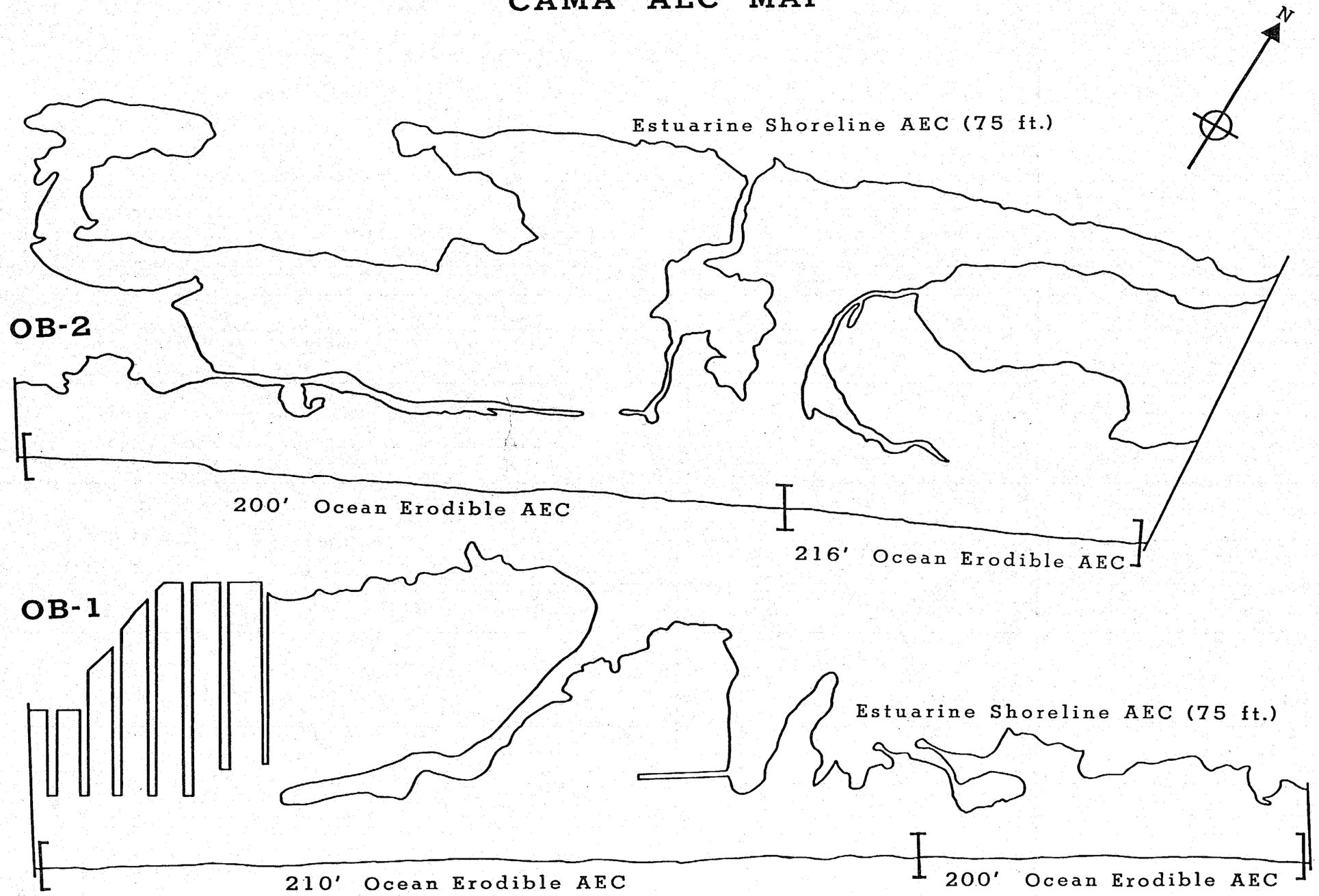

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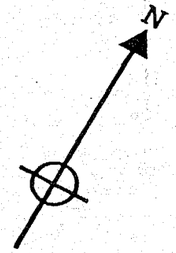
Figure 6.5

CAMA AEC MAP



Inlet Hazard AEC

Estuarine Shoreline AEC (75 ft.)

Scale: 1-inch equals 1600-feet

OB-4

286' Ocean Erodible AEC

OB-3

Estuarine Shoreline AEC (75 ft.)

236' Ocean Erodible AEC

Figure 6.6

COMPOSITE HAZARD MAP

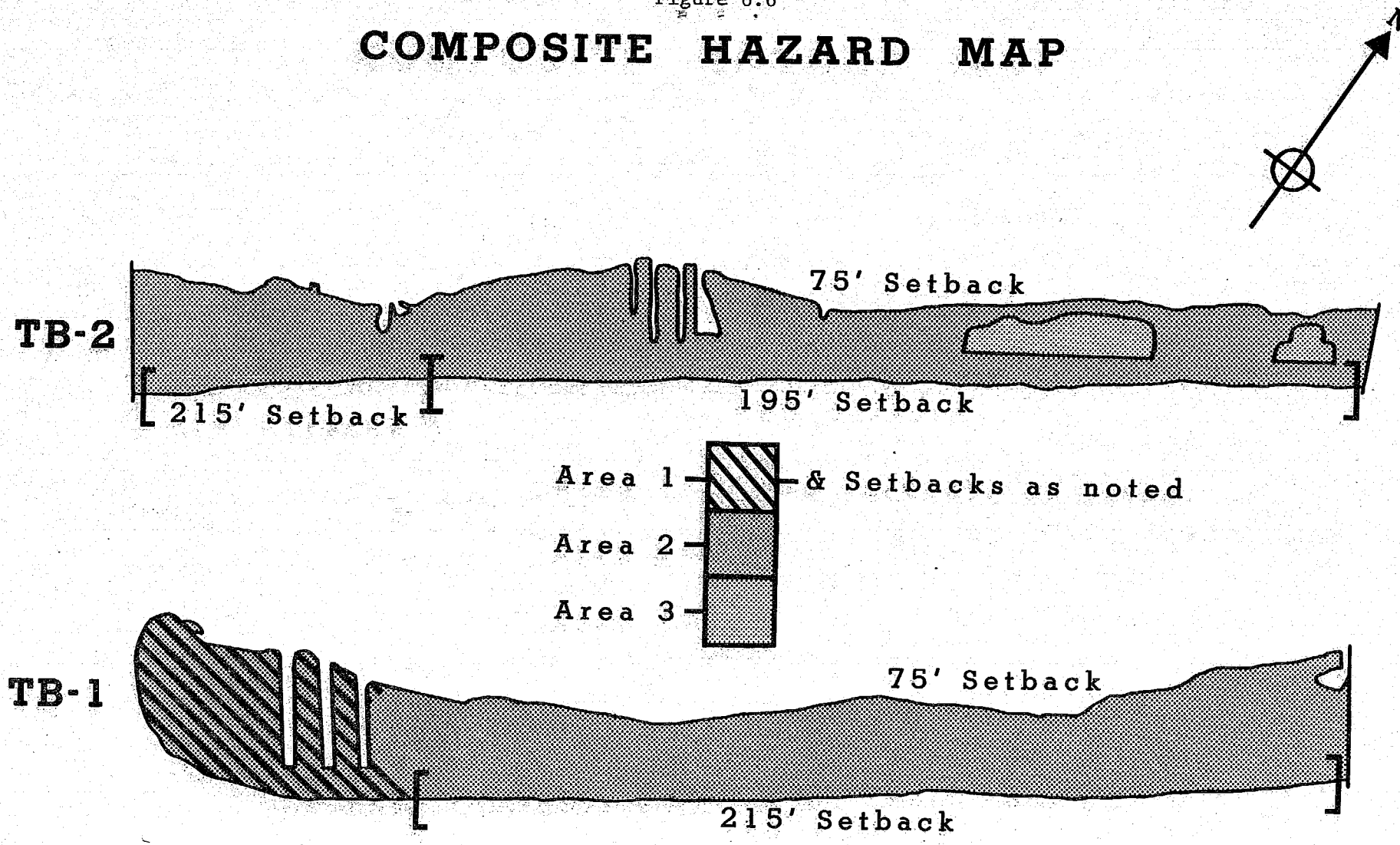


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Figure 6.6

COMPOSITE HAZARD MAP

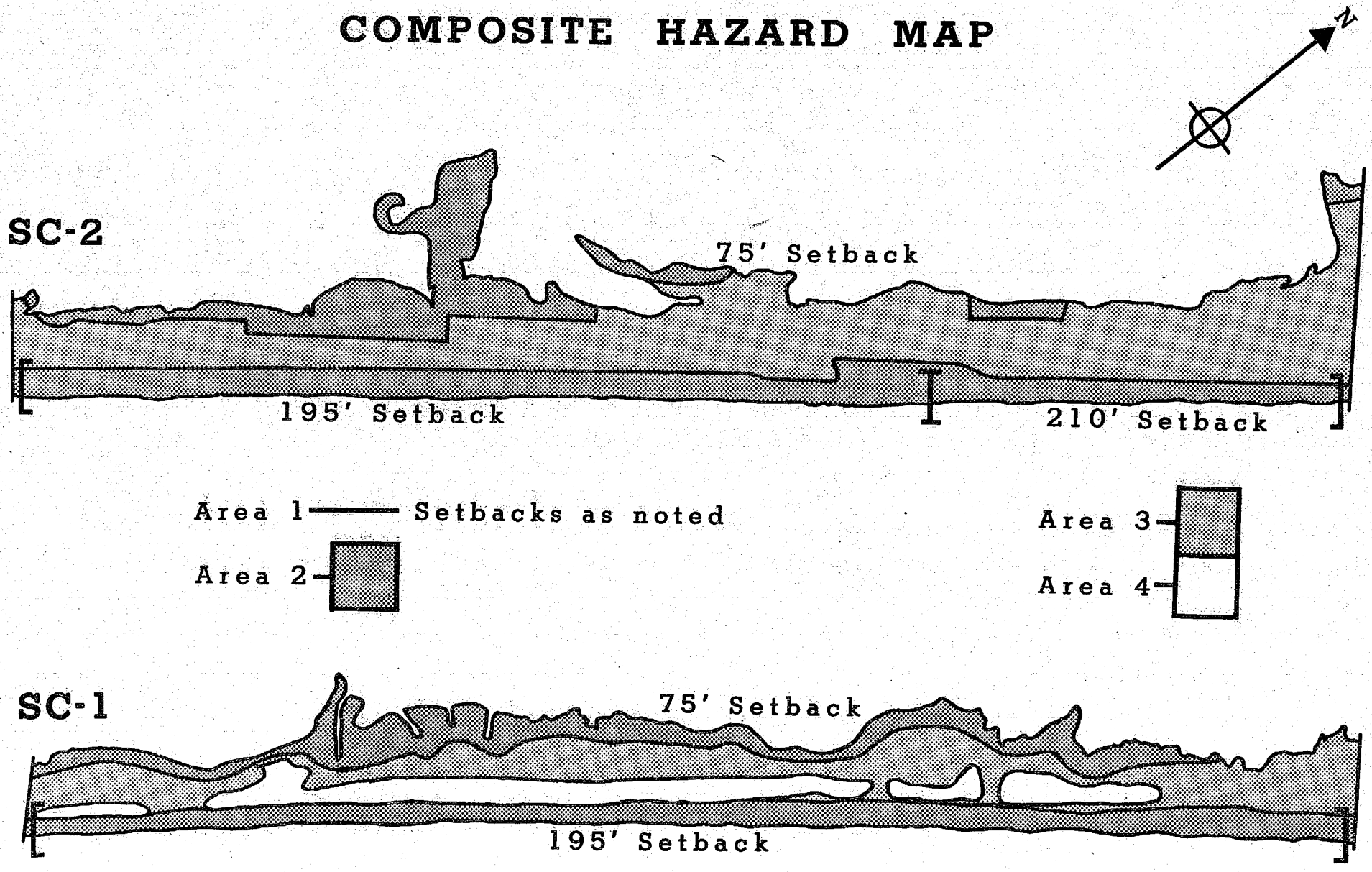

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Figure 6.6

COMPOSITE HAZARD MAP

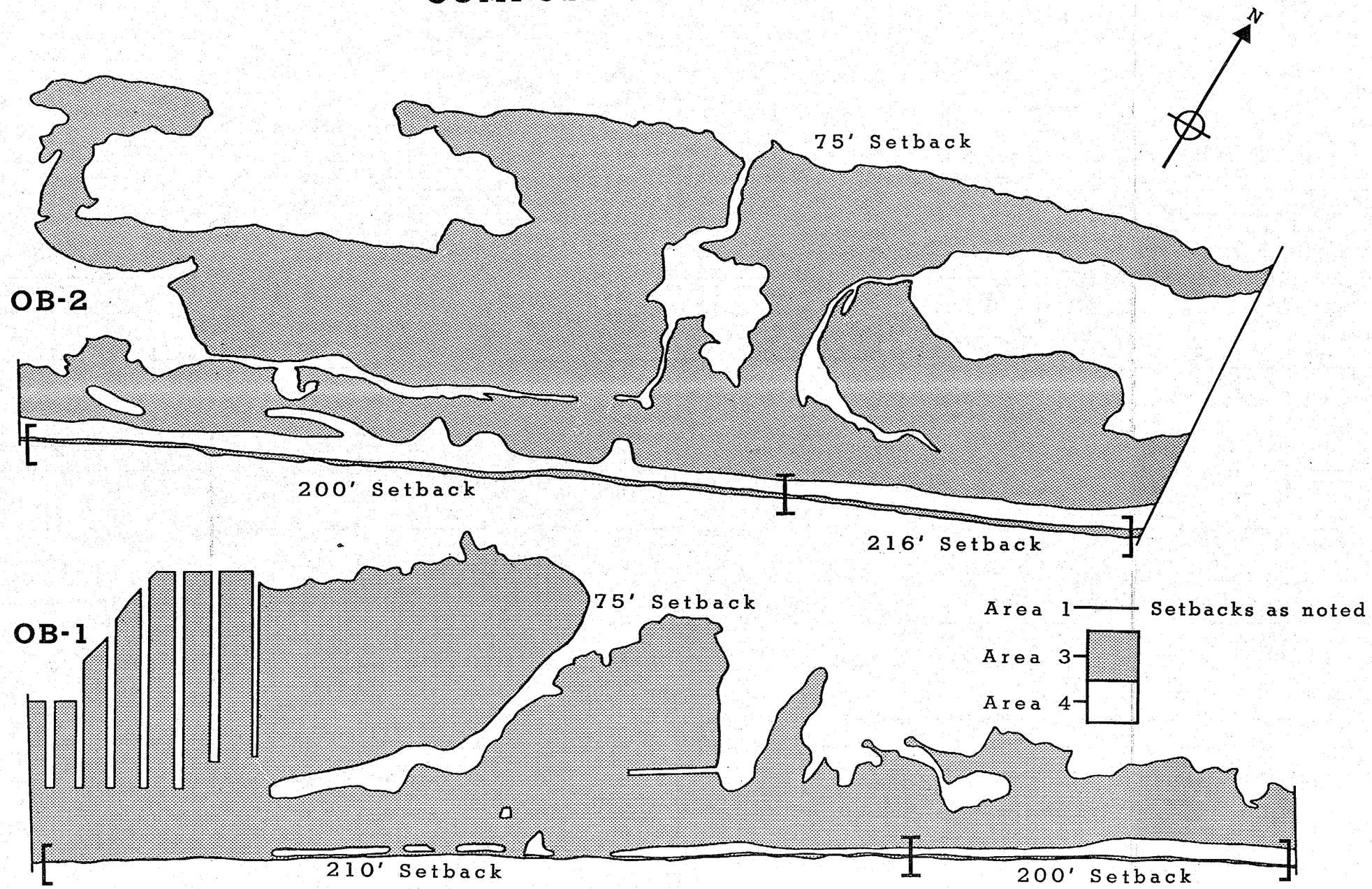

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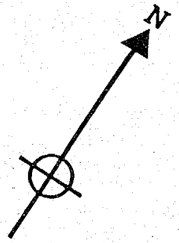
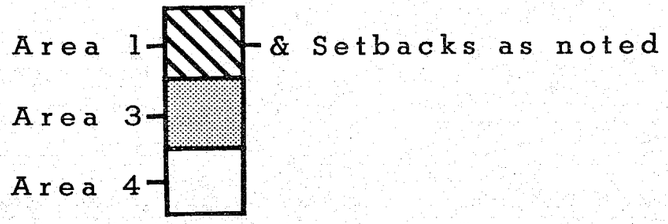
Figure 6.6

COMPOSITE HAZARD MAP





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Severity of Risk

The severity of risk is basically a function of the number of physical forces (erosion, wave action, etc.) that a hurricane is likely to impose on a particular hazard zone. The Composite Hazard Map shows different hazard areas with different levels of risk (see Table 6.1). Area 1 is the area at most severe risk due to its being subject to the full complement of hurricane

Table 6.1: Definition of Hazard Areas

Area	Forces Present/Expected: Erosion	Wave Action	Flooding	High Winds	Boundaries
1	X	X	*X	X	Ocean erodible AECs, inlet hazard AECs, estuarine shoreline AECs
2		X	X	X	Flood insurance V-zones
3			X	X	Flood insurance A-zones
4				X	Rest of community

forces. Area 4 faces the least severe risk on the island since, in a major storm, it can reasonably be expected to suffer only high winds. (This by no means implies that Area 4 is risk-free; hurricane winds are a serious force to contend with and must be accounted for in any hurricane-related planning effort. In the event of a hurricane, all of Topsail Island will face severe damage.) Using the Composite Risk Map as a guide to the location of hazard areas and the levels of risk they entail, it was then possible to get a rough idea of the magnitude of risk facing each community on Topsail Island by comparing the Composite Hazard Map to the pattern of existing and expected development on the island.

Magnitude of Risk

The magnitude of risk is basically a function of the size of the population and the number and value of developed properties exposed to the hurricane forces likely to affect a hazard area. To estimate the magnitude of risk facing Topsail Island, the Composite Hazard Map was overlain with the land use maps of each community on the island.

Topsail Beach, Surf City, and Onslow County each had land use maps identifying the location of all buildings on the island; the maps were coded to indicate residential and commercial structures. Although the land use

maps for Surf City and Topsail Beach were prepared for the 1980 land use plan update, they were compiled from 1977 survey data. Thus it was necessary to conduct "windshield surveys" to update the maps. Unless a community has a recently completed land use map, it will probably be necessary to update the maps through an inspection of the community. The Onslow County Planning Department maintains an up-to-date inventory of structures for West Onslow Beach showing property lines, zoning districts, and whether or not a property is developed. This map is kept current as new construction occurs, buildings are moved, or buildings are torn down. Maintaining an on-going inventory such as this is a good idea for other communities. It provides a ready source of information concerning the development pattern of the community and is useful for policy decisions.

Existing Development --

An assessment of the magnitude of risk facing existing development on Topsail Island was obtained by counting the number of residential and commercial structures in each of the three jurisdictions which were located in the various hazard areas identified on the Composite Hazard Map. The location of roads, utilities, and public buildings was also examined.

The entire town of Topsail Beach falls into hazard areas 1, 2, and 3. Of the 611 residential units in Topsail beach, 49 percent (or 298) are in Area 1 (the ocean erodible AEC, inlet hazard AEC, and estuarine shoreline AEC). Fifty-one percent (or 312) are in Area 2 (the flood insurance V-zone), subject to flooding and wave action during a 100-year flood. Thus, every home but one is in either Area 1 or Area 2; the other home is in Area 3 (the flood insurance A-zone). Eleven of the 37 commercial structures in the town are located in Area 1; the remaining 26 are in Area 2.

In Surf City, 282 (28 percent) of the town's 995 residential units are in Area 1. Another 217 (22 percent) are in Area 2. Another 437 (or 44 percent) fall into Area 3, with the remainder falling into Area 4. Ten of the 70 commercial structures in Surf City are located in Area 1; another twenty are located in Area 2. The rest are in Area 3.

Because Onslow County is not yet enrolled in the Regular Program of the National Flood Insurance Program, rate maps delineating V-zones do not yet exist; therefore, the Composite Hazard Map does not show an Area 2 for West Onslow Beach. Area 3 covers the land in West Onslow Beach that is classified as the "special flood hazard area" (A-zone) by the flood hazard boundary map for Onslow County. Of the 1,225 residential units in West Onslow Beach, about 315 (26 percent) fall into Area 1. Another 790 (65 percent) fall into Area 3. Forty-five percent of the residential units lie in an area of extensive finger canals that appear in Area 3 but are likely to suffer more storm forces than just flooding and high winds. A large condominum development containing 180 units lies at the eastern end of the island, partially in the ocean erodible AEC and very close to the inlet hazard area.

Table 6.2 shows the number of residential and commercial units in each jurisdiction that fall into the various hazard areas.

Table 6.2: Number of Structures in Hazard Areas

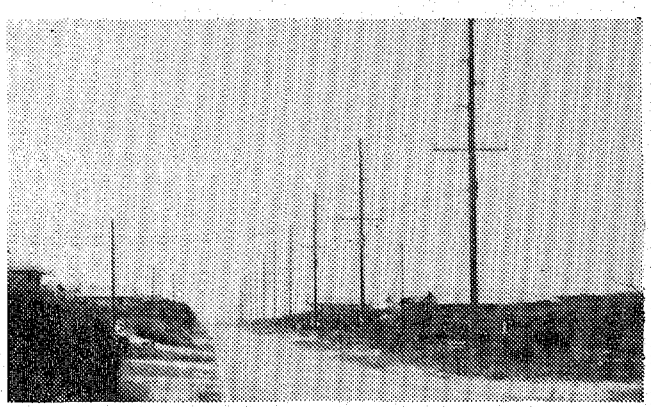
	Topsail Beach		Surf City		West Onslow Beach	
	Number	%	Number	%	Number	%
Residential Units						
Area 1	298	49	282	28	315	26
Area 2	312	51	217	22	N/A	
Area 3	1	<1	437	44	790	64
Area 4	0	0	59	6	120	10
Total	611	100	995	100	1,225	100
Commercial units						
Area 1	11	30	10	14	6	35
Area 2	26	70	20	29	N/A	
Area 3	0	0	40	57	11	65
Area 4	0	0	0	0	0	0
Total	37	100	70	100	17	100

The roads, utilities, and other public facilities on Topsail Island were also examined for vulnerability. There is a single primary road (N.C. 50 and 210) along the length of the island. Through Surf City, the road is located as far inland as possible, the right-of-way having been moved from its original location along the oceanfront. One section of the road floods consistently in minor storms. In Topsail Beach, the primary road remains along the oceanfront and, due to the narrowness of the island at this point (0.2 miles), will likely remain there. North of the Route 210 bridge in West Onslow Beach, the road runs directly adjacent to the dunes and oceanfront. This section of the road has long been recognized as hazardous, and private developers working in this area have already begun taking steps to move it. Everywhere on the island, the primary road is subject to inundation by the 100-year flood. In Topsail Beach, the road lies entirely in Areas 1 and 2 and is subject to the more severe damaging forces of wave action and erosion. The location of secondary roads on the island basically coincides with the location of homes and businesses.

The Jones-Onslow Electric Membership Corporation's electric lines are situated on overhead poles along the primary roads. These poles pose a danger on the island in the event of a hurricane; with a single route of evacuation, a fallen pole could be disastrous.

The towns on Topsail Island have limited community facilities. All schools, health care facilities, and courthouses are located on the mainland, a sufficient distance inland to be relatively safe from hurricane damage. Topsail Beach and Surf City do, however, each have a town hall, housing the municipal offices and police departments. Topsail Beach's town hall is not

elevated and lies in Area 2 (the V-zone), where it will be subject to wave action, flooding, and high winds. (The town originally intended to build a two-story structure, with the upper floor safe from flooding, but could not afford to install an elevator to provide the required access for handicapped persons.) Surf City's town hall is located in Area 3 (the A-zone); it is a two-story building, with the upper floor used for administrative offices and the lower floor housing the police and public works departments.



Overhead power lines threaten Topsail Beach's sole evacuation route.

A study conducted in the spring of 1982 by the U.S. Army Corps of Engineers sheds light on the cost of damages that existing development on Topsail Island could expect to suffer during a hurricane. The Corps's Wilmington District office surveyed nearly every existing structure on the island, estimated its value, and estimated the damages to each structure from flooding at different levels (the 500-year storm, the 100-year storm, the 50-year storm, etc.). The results of the study (see Table 6.3) indicate that, in the 100-year storm, the town of Topsail Beach can expect almost 13 million dollars in damages, the town of Surf City can expect over seven million dollars in damages, and West Onslow Beach can expect over 15 million dollars in damage. The study dealt with damages from flooding only, not including the further damages that erosion, wave action, and high winds would cause.

An assessment of the vulnerability of existing development on Topsail Island pointed out four sites of special concern on the island due to the severity of hazards present and the density of development at each site.

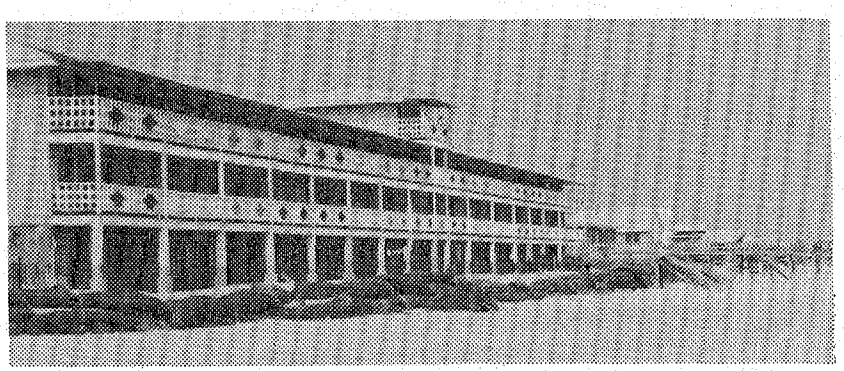
The first site of special concern is the western mile of beachfront development in Topsail Beach, which faces high erosion rates and contains finger canals which cut very close in to the main road and the beach. In 1974, with the assistance of the N.C. Department of Water and Air Resources, a system of seven sand bag groins was installed along this section of beach to help retard erosion. More recently, sand has been pumped in from the sound in an attempt to renourish the beach and dunes. However, erosion continues along this stretch of beach; attempts to stabilize a highly unstable area may prove futile. Most of this stretch of beach has few dunes to protect it. Several homes at this end of the island have already been moved after ocean erosion exposed their septic tanks and rendered the lots unbuildable. The ground floor of the Sea Vista Motel, an unelevated structure along this stretch of beach, was flooded by high tides in the fall in 1981. The future of buildings in this area remains uncertain. Normal erosion threatens their existence; a hurricane would seal their fate.

Table 6.3: Estimates of Damages on Topsail Island from Storms of Different Frequencies

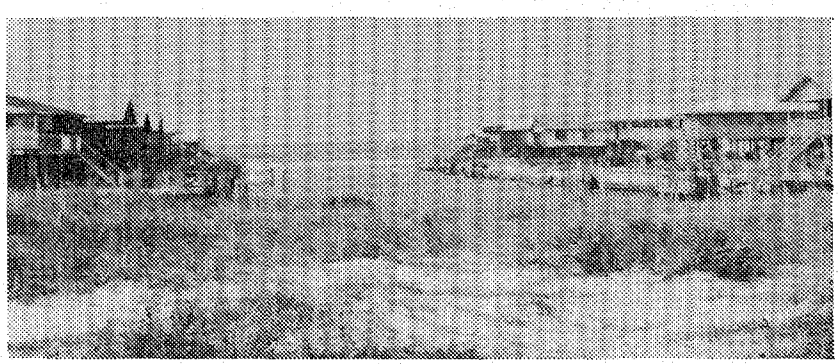
Jurisdiction	Storm Frequency (in years)	Damage Values (Real & Personal Property) in thousands of dollars* Residential	Commercial	Total
Topsail Beach	500	18,088.1	4,052.6	22,140.7
	100	10,125.8	2,580.4	12,706.2
	50	7,342.7	1,706.8	9,049.5
	25	2,276.6	201.9	2,478.5
Surf City	500	13,220.7	3,394.4	16,615.1
	100	5,545.6	1,711.6	7,257.2
	50	631.9	134.3	766.2
	25	269.5	29.5	299.0
West Onslow Beach	500	23,749.0	2,237.2	25,986.2
	100	13,588.8	1,485.7	15,074.5
	50	6,585.0	1,112.0	7,697.0
	25	2,875.8	700.9	3,576.7
TOTAL (all jurisdictions)	500	55,057.8	9,684.2	64,742.0
	100	29,260.2	5,777.7	35,037.9
	50	14,559.6	2,953.1	17,512.7
	25	5,421.9	932.3	6,354.2

*Values reflect March 1982 price levels.

Source: U.S. Army Corps of Engineers - Wilmington District, 1982.



Severe erosion on the island's western tip leaves this motel and these homes extremely vulnerable to storm damages. Several homes along this stretch have already been moved to other parts of Topsail Beach.



Looking soundward from the scene above, only a two-lane road and a narrow stretch of beach separate this finger canal from the ocean.

The finger canals at this end of the island compound the hazard. The only things separating the canals from the ocean are a two-lane road and a narrow beach. Minor winter storms have in the past caused a temporary breaching of the island at this point. Many homes are built along the finger canals; fortunately, these are all elevated to or above 13 feet (the 100-year flood level) and thus have some protection against flooding. Nonetheless, the threat of the island being breached and extensive damage to homes, businesses, roads, and water lines occurring at this point is very strong.

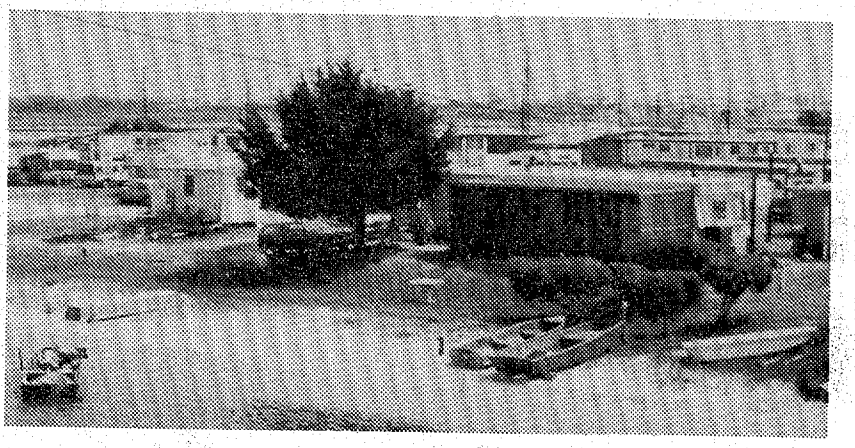
The second site of special concern is the mobile home parks located in Surf City. Mobile homes are often situated very close together and are seldom elevated. One large park is located in Surf City at Barnacle Bill's Pier, on oceanfront land where the dunes are broken and elevations are generally less than ten feet. Several other mobile home parks are located in Surf City along the soundfront, on either side of the Highway 50 swing bridge. The mobile homes here are also unelevated, grouped close together, and set very close to the water without protection. These mobile homes are all in the V-zone, and many are in the estuarine shoreline AEC as well.

The third site of special concern is an extensive finger canal system in West Onslow Beach, just north of the Town of Surf City. This site consists of seven finger canals lined with about 500 homes. Most of these homes are mobile homes set directly on the ground. Since finger canals involve artifically dredged and filled land, this land could easily shift and erode under the forces of a hurricane. Adjacent to these finger canals, on the oceanfront just north of the Scotch Bonnet Pier, is a large mobile home subdivision located on a flat strip of land with broken dunes and low elevations. This area was washed over by Hurricane Hazel and remains as a potential overwash pass.

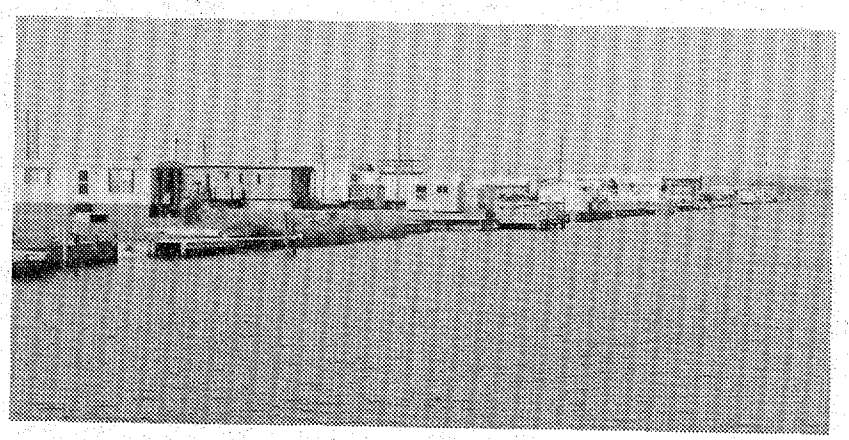
The final site of special concern is the Topsail Reef condominium development at the eastern end of the island in Onslow County. Here, 240 residential units have been built 1,000 feet from the New River Inlet, which is migrating towards them at a rate of 20 feet per year. In addition to bordering the inlet hazard area, the dunes along this section of beach are particularly low and discontinuous, so storm surge flooding and wave battering are highly likely. As a result, the highest density development on Topsail Island is located at one of its most hazardous areas.

Future Development --

In addition to existing development and the hazards facing it, significant future growth can be expected on Topsail Island, mainly in West Onslow Beach.



Mobile homes are common in Surf City.



The same is true for West Onslow Beach, where low-lying mobile homes line an extensive system of finger canals.

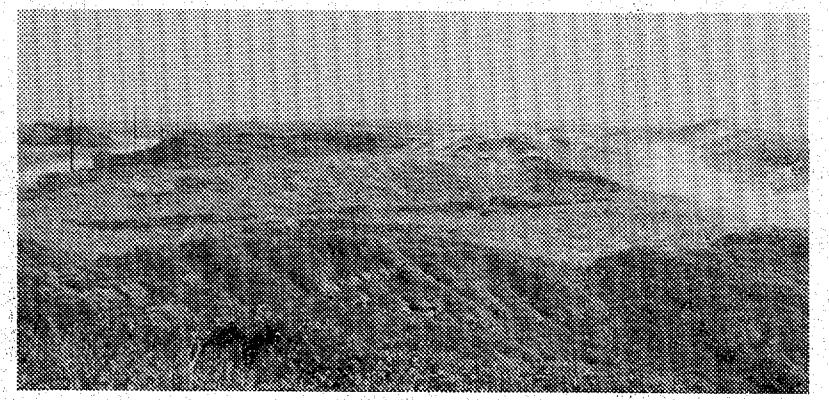
West Onslow Beach contains approximately 3,292 acres of land. Of this, 1,789 acres are zoned as a Conservation District where little or no development is allowed to occur. Of the remaining 1,503 acres, 1,250 acres are presently undeveloped (Onslow County Planning Department, March 1982 data). This includes about 70 percent of the oceanfront -- a total of 8.4 miles. The development of Topsail Reef condominiums at the eastern end of the island foretells the scale of development West Onslow Beach can expect as this stretch of relatively undeveloped island appeals to developers and potential homeowners. The developer of Topsail Reef condominiums has, with the approval of the N.C. Division of Environmental Management, begun construction on a privately-financed and privately-maintained one-million-gallon-per-day sewage system for West Onslow Beach, with the capacity for expansion to three million gallons per day. This system would serve a 582-unit condominium development he plans to build just west of Topsail Reef, as well as a 600-unit development that another developer has proposed for Permuda Island (a low-lying soundside island that is connected to Topsail Island by a low, narrow, and unpaved causeway). A large portion of West Onslow Beach has been designated as "undeveloped coastal barrier" by the U.S. Department of the Interior in response to the Omnibus Budget Reconciliation Act of 1981; this portion of the island will be ineligible for federal flood insurance after October 1, 1983.

The towns of Surf City and Topsail Beach can also expect to continue developing, though not as dramatically. While the sort of large-scale, multi-unit development which characterizes Atlantic Beach and Wrightsville Beach has not affected Surf City or Topsail Beach, their smalltown characters cannot be guaranteed. With 470 acres available for development in Surf City (John J. Hooton and Associates, 1981, p. 8) and 164 acres available in Topsail Beach (John J. Hooton and Associates, 1980, p. 22), the pressures to build will continue.

Evacuation of Topsail Island in the event of a hurricane is not seen as a problem at the present time. The two bridges leading off the island -- Route 210 at the northern end and Route 50 in the middle -- are collectively able to transport at least 1,500 vehicles per hour given ideal conditions. With a 12-hour warning time, 18,000 vehicles could be safely evaucated from the island. While this is substantially greater than the number of vehicles present on Topsail Island at any given time now, the future growth and resort popularity of the Island could greatly increase traffic. The capacities of the roads and bridges of Topsail Island for hurricane evacuability must be recognized and monitored in the future.

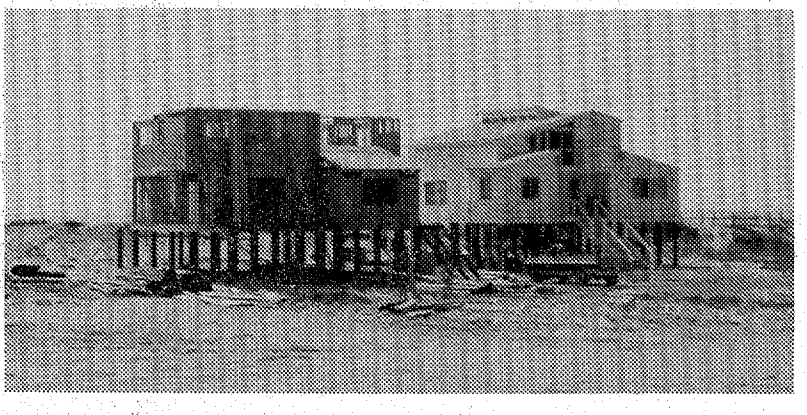
REVIEWING CURRENT MITIGATION MEASURES

Mitigation measures currently in place on Topsail Island reflect the different goals and objectives of the three jurisdictions involved and, to a certain extent, the differing levels of vulnerability along the island. Local policies in Topsail Beach, Surf City, and West Onslow Beach therefore offer three different approaches to hurricane hazard mitigation in covering both new development and the reconstruction of damaged buildings.



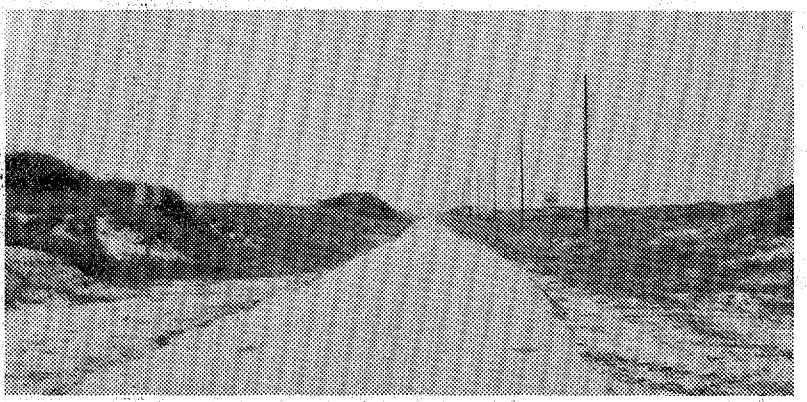
Most of West Onslow Beach remains undeveloped.

Construction there proceeds at a hearty pace.



These condominiums foreshadow things to come on the eastern end of West Onslow Beach.

This narrow and poorly-maintained road is their only route out.



Topsail Beach

Topsail Beach, at the southern end of the island, is the most vulnerable to hurricane damages. With 99 percent of all buildings in the V-zone, Topsail Beach has the greatest amount to lose. Perhaps it is not surprising, then, that Topsail Beach has adopted the most extensive and effective measures for protecting against hurricane damages.

The Topsail Beach Land Use Plan (adopted 1976, updated 1980) provides guidelines for the town's future development, including land classifications and natural resources and community development policies which deal with the type, location, and timing of development. The plan stresses the objectives of maintaining only single-family development in Topsail Beach and protecting the community from damage by long-term erosion and storm forces.

Within the Town Code, and adopted as the force of law, are Topsail Beach's floodplain management regulations. Using the town's flood insurance rate map as an overlay for the zoning map, the floodplain management regulations require that:

1. Non-residential structures must be elevated or flood-proofed to 13 feet above MSL;

2. Structures in the V-zone must have open space or breakaway walls below base flood elevation;

3. Pilings, anchorages, and breakaway walls must be approved by the building inspector;

4. No dunes may be altered;

5. No use of fill for structural support shall occur in the V-zone; and

6. No mobile homes may locate in the V-zone.

The regulations mirror the minimum regulations required by the National Flood Insurance Program for participation in its Regular Phase. All new construction and those structures undergoing "substantial improvements" (repairs or reconstruction greater than 50 percent of fair market value) must comply with the floodplain management regulations.

Topsail Beach has also adopted a zoning ordinance and subdivision regulations which strictly regulate mobile homes and multi-family dwellings. The establishment of a mobile home park or the building of multi-family structures (such as condominiums) is not permitted by right anywhere on the zoning map. To do so requires a special use permit from the Town's Board of Commissioners. The zoning policies governing non-conforming uses and structures are particularly relevant for post-hurricane reconstruction. Non-conforming uses may not be rebuilt in a residential district if reconstruction exceeds 50 percent of replacement cost. Non-conforming uses may not be rebuilt in any other zoning district if reconstruction exceeds 70 percent of replacement cost. Non-conforming structures (i.e. those not meeting setbacks and other requirements) may not be rebuilt in any district if reconstruction exceeds 75 percent

of replacement cost. These requirements supplement those in the floodplain management regulations governing the repair of damaged structures. These requirements ensure that, in the event of destruction by a hurricane or other disaster, hazardous uses and structures will not be re-established and the town's development goals, as outlined in the land use plan, the floodplain management regulations, and the zoning ordinance, will be furthered.

Surf City

Surf City's policies are in many ways similar to those of Topsail Beach, but allow a broader scale of development. The town's land use plan expresses Surf City's desire to "maximize a structure's protection from wind and water and to minimize damage to the protective land forms of dunes and beaches," (John J. Hooton and Associates, 1981, p. 26). Within the Surf City Town Code is a flood damage prevention ordinance which is essentially identical to Topsail Beach's floodplain management regulations. It too requires that:

1. residences new construction, or substantial improvements (repairs or reconstruction worth 50 percent of market value) must be elevated at or above base flood level (13 feet above MSL) in V and A-zones;

2. commercial buildings must be elevated or floodproofed to the base flood level in these zones;

3. open space or breakaway walls must be used below base flood elevations in the V-zones;

4. anchorings and pilings must be certified by a registered engineer or architect;

5. no alteration of dunes or use of fill for structural support shall occur in the V-zone.

In Surf City, mobile homes are not as strictly regulated as in Topsail Beach. Because over 30 percent of the housing stock in Surf City is presently mobile homes, stringent regulation is not as politically feasible. Instead, Surf City's zoning ordinance has designated specific districts in the town where trailers and mobile homes are permitted. Additionally, mobile homes cannot locate in the high hazard flood area (V-zone) except in an existing mobile home park or subdivision. All new parks and subdivisions (and extensions to existing ones) and mobile homes not in a park or subdivision must have the lowest floor elevated to base flood level (13 feet above MSL). Mobile homes which are substantially damaged must be elevated to 13 feet and be no closer than 15 feet to another structure. Mobile homes may not be rebuilt outside the Town's R5M zoning district (which exists in only three areas in town where there are already mobile home developments).

Surf City's zoning ordinance also allows more liberally for multi-family structures than does Topsail Beach's zoning ordinance. The ordinance allows multi-family construction in residential districts as long as it meets the town's height and lot size restrictions.

Whereas non-conforming structures must meet the town's elevation, lot size, and height requirements if they are substantially damaged, the zoning ordinance allows non-conforming uses to rebuild provided no further non-conformity occurs (that is, without increasing space or further violating dimensional requirements).

West Onslow Beach

The eastern half of Topsail Island is the unincorporated area of West Onslow Beach, administered by Onslow County. Since West Onslow Beach is largely undeveloped, the policies there reflect a more growth-oriented attitude towards development than those in Topsail Beach or Surf City, and a lesser recognition of the hurricane hazard. The Onslow County Land Use Plan recognizes that "West Onslow Beach will grow by leaps and bounds barring problems associated with hurricanes" (Onslow County Planning Department, 1981, p. 81). The County expects development to occur at a high pace, including single-family residences, condominiums, and hotels. The County maintains no floodplain regulations or elevation requirements for West Onslow Beach. The County does have zoning and subdivision regulations and planned unit development (PUD) standards in force on West Onslow Beach, but these are vague and ineffective at addressing hurricane hazards. Mobile homes and multi-family condominiums are permitted at West Onslow Beach, subject to the zoning ordinance's lot size restrictions. For reconstruction following a hurricane, the Onslow County zoning ordinance states that non-conforming structures and uses may not be reconstructed if damaged beyond 60 percent of replacement cost.

The County does have a "conservation" zone in place that is designed to protect floodplains and estuaries. This district covers over half of the land in West Onslow Beach, entirely on the soundside of the island. The County's land use plan supports the use of elevation and setback requirements to protect development from flood hazards; it also states that the County intends to adopt more stringent floodplain management regulations (similar to those in Topsail Beach and Surf City) once the Federal Insurance Administration has the County's flood insurance rate maps prepared and the County enters the Regular Phase of the National Flood Insurance Program. However, the rate maps will not be ready before autumn of 1983, if not later. Meanwhile, development in West Onslow Beach continues; most new construction is fortunately elevated to take advantage of lower flood insurance rates. The state's CAMA regulations also play a major role in determining whether or not new development reasonably protects itself against hurricane damages by enforcing the ocean erosion setback and standards for construction in ocean hazard AECs.

In addition to the above local regulations, the three jurisdictions on Topsail Island operate under the various requirements that state agencies use to govern development (as described in the preceding chapter). Each jurisdiction administers CAMA's standards for minor development projects in areas of environmental concern. The Office of Coastal Management handles major projects in AECs as well as proposals to dredge and fill in estuarine waters and wetlands. All development must comply with the State Building Code, which is administered by the local governments. None of the three jurisdictions varies from the code.

Table 6.4: Local Policies In Effect on Topsail Island

Local Policy	Topsail Beach	Surf City	West Onslow
1. Floodplain regulations	X	X	
• elevation or flood-proofing required	X	X	
• open space, breakway walls below flood level in V-zone	X	X	
• no alteration of dunes	X	X	X
2. Zoning ordinance	X	X	X
• restrictions on mobile homes	strict	moderate	slight
• restrictions on multi-family	strict	moderate	slight
3. Subdivision regulations	X	X	X
4. Land Use Plan	X	X	X
• development outlook	single-family	mixed	high-density
5. Destruction level to deny rebuilding non-conformities	50%-75%	50% for structures; none for uses.	60%
6. National Flood Insurance Program	Regular	Regular	Emergency

Even though each jurisdiction on Topsail Island exercises some level of control over development that covers the different hazards associated with hurricanes, each jurisdiction suffers to some degree from problems in enforcing local and CAMA regulations. Enforcement problems arise for three reasons. First is the ill-defined role of local government in regulating development, which grows out of public attutides toward the use of private property. Second is the lack of compliance on the part of developers. Third is the lack of staff and other resources for carrying out enforcement actions. By and large, development on Topsail Island has complied with the appropriate regulations. However, a few concerns surfaced during discussions with local officials in Topsail Beach, Surf City, and Onslow County. These concerns have

a definite bearing on whether or not development on Topsail Island is reasonably safe from damage and whether or not Topsail Island officials can rest assured that post-hurricane reconstruction will be expedient and leave the community safer than it was before the storm.

The role of local government in regulating development is not strongly defined on Topsail Island. Part of this stems from the lack of public acceptance that such a role should exist. The attitude of each jurisdiction varies as each has grown accustomed to different types of development and has faced different development problems. Topsail Beach, which wishes to remain primarily a single-family residential community, maintains the strictest control over the type and location of development and invests a good deal of effort in formulating and enforcing development regulations given the limited resources that it has available. Surf City, which is a more diverse residential and business community maintains a slightly less restrictive attitude towards development and thus tends to channel its attention to other priorities. Onslow County, which governs relatively undeveloped West Onslow Beach, expects its half of the island to grow significantly in the next five to ten years and has so far taken little action to ensure that this development enjoys maximum protection from hurricane damage.

All of the communities on the island are taking action to protect the oceanfront dunes -- their first line of defense.

Enforcement efforts in each community are hampered by the efforts of those who seek to evade the regulations. Stories of construction at odd hours or on weekends to avoid building inspection are common. It is impossible for each jurisdiction to achieve 100 percent enforcement given the limited resources each has on hand.

A problem common to all three jurisdictions is the limited number of qualified personnel and resources for enforcement purposes. As small towns with limited revenues, neither Topsail Beach nor Surf City employs a full-time inspector or planner. Each town has a part-time building inspector. Subdivision reviews and requests for zoning variances go directly to the Board of

Commissioners. Onslow County has a full-time planning department, but with one inspector responsible for all of Onslow County, there is limited time available for West Onslow Beach projects.

The three jurisdictions on Topsail Island can expect to have serious problems in managing post-hurricane reconstruction. The local inspectors have had little if any training and experience in damage assessment. To determine if non-conforming structures must be rebuilt to current requirements, an inspector must be able to specify the level of destruction. The lack of experience in damage assessment, together with the widespread destruction that will accompany a hurricane, presents a nearly impossible task for local inspectors and other local officials on Topsail Island, especially since the will all be called on in the emergency to fulfill a variety of responsibilities.

IDENTIFYING MITIGATION PROBLEMS

An identical question was posed to officials in each of the three jurisdictions in separate meetings and their responses were listed and ranked according to priority. The question was, What are the most serious problems that your community faces in influencing private and public development and reconstruction to minimize hurricane hazards to life and property? Not surprisingly, they identified many common problems which they felt impeded their efforts to mitigate the effects of hurricanes. The problems fall into two categories: philosophical and administrative.

Philosophical Problems

The main philosophical problem in managing development to reduce the risk of hurricane damages involves determining an acceptable level of risk for individuals and the community to take, and determining an acceptable level of government control over development in the community. The popular conception of hurricanes along the North Carolina coast is that of a low-probability event. This is due to the unusual lull in hurricane activity of the past 25 years. This attitude is further exacerbated by the availability of federal flood insurance. The certainty of enjoying a house insured from damages seems to outweigh the threat of potential damages. Mayors in both Surf City and Topsail Beach feel that a major problem in their communities is the attitude of citizens towards private property rights and the role of government. People tend to resent government regulation in what they feel are individual decisions of risk-taking with private property. This individualistic attitude towards risk-taking has made attempts at collective standard-setting a constant battle. It also creates a political climate that works against the adoption of stringent regulations which protect development and post-disaster reconstruction from storm damages.

Another major problem Topsail Island faces in influencing or managing development is the many different pressures which exist to develop. These pressures can take the form of internal pressures within local government to grow and expand its tax base, especially as the cost of government services continues to rise. Pressures also come from outside developers who recognize

the large amount of developable land on Topsail Island and seek a profit. State and federal agencies are a third source of development pressure in that they award grants-in-aid to communities for projects which will accommodate growth, such as roads and wastewater treatment systems. On Topsail Island, the upgrading of the primary road and the construction of the second, fixed-span bridge opened up the island for more extensive development. This implicit state and federal philosophy of encouraging expansion has contributed to local difficulties in managing development.

These philosophical problems were the first and most obvious for officials on Topsail Island to identify, and are no doubt shared by communities all along the North Carolina coast. However, these basic problems are the hardest to address and lie at the core of hazard mitigation efforts. Agreement can be widely found on the need for hurricane protection and preparedness, but deciding on a specific approach for meeting the need remains a difficult decision for local officials in each of the three jurisdictions.

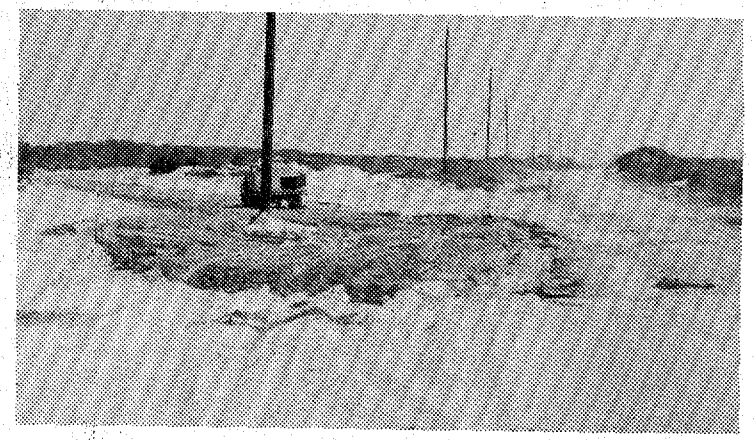
Administrative Problems

A major administrative problem facing each jurisdiction is their inability to lobby for changes at the state and federal level, even though state and federal programs (CAMA, the State Building Code, and the National Flood Insurance Program) play major roles in controlling the location and quality of development on Topsail Island. For example, officials in the Town of Topsail Beach felt that as a small town of only 130 voters, they had little or no political clout with Pender County, the state, or federal agencies. The Mayor and Board of Commissioners are concerned about the adequacy of the State Building Code for coastal communities. They feel that requiring sprinkler systems in the town's motels and condominiums would help to save lives and avert damages, but such a regulation must come from the State Building Code Council. The Town lacks the resources to prepare the engineering study required by the Council before it will permit a variance to the state code.

Surf City officials identified another problem which reflects each jurisdiction's constrained resources and is relevant for other coastal communities. It is presently a small community of single-family houses, mobile homes, and small businesses. If proposals for large-scale developments or subdivisions are brought forward, the Town has no personnel with the experience to adequately review such a project. The subdivision regulations were written under contract, by professionals, but must be administered by part-time local officials. A program of technical assistance for project review would be helpful. A similar problem can be expected to occur during post-hurricane reconstruction, where the experience and technical expertise of local administrators will be insufficient to handle the burden of regulating reconstruction.

For West Onslow Beach, the primary problem identified by the Onslow County Planning Department is the lack of input into or control over the development process. Development regulations were seen as vague and needing to be further defined and strengthened. A new development project at West Onslow Beach will relocate part of the primary road and new sewer system along a better protected right-of-way located farther from the oceanfront. Onslow County would prefer the entire right-of-way to be located farther in from the

beach, especially if the sewer system is later to be transferred over to County ownership and maintenance. The Planning Department could have been used to coordinate efforts among the developers, the N.C. Department of Transportation and the N.C. Division of Environmental Management. Instead, the County has been left outside of the process and decisions regarding the project are proceeding on a piecemeal basis.



A private developer is moving the road along the eastern end of the island so he can set new ocean-front homes back from the beach.

A problem common to all three jurisdictions, and one that local officials felt should be a top priority, is the lack of a plan or set of guidelines for reconstruction following a hurricane or other major storm. Local officials on Topsail Island want to avoid the chaos that followed Hurricane Hazel in 1954 regarding the character, location, and timing of reconstruction. During and after a hurricane, local officials in a small coastal community, such as Surf City or Topsail Beach, must fill a myriad of roles, not only in managing reconstruction but also in managing the full range of emergency activities and services. With such divided attention, it is difficult for local officials to oversee reconstruction activities to make sure that they comply with the requirements and long-term goals of the community and help reduce the risk of future damages. With local officials facing pressure from the public to allow rapid reconstruction and pressure from their other emergency functions, it is not unusual for rebuilding to occur in a haphazard fashion that leaves the community only as safe, or unsafe, as it was before.

The three communities on Topsail Island, as separate political jurisdictions, each need to develop a reconstruction plan. The levels of hazard present on the island, and the limited resources each community has available to handle reconstruction, call for the communities to prepare themselves, taking stock of the policies they will use to guide reconstruction and the procedures by which these policies will be applied. While each jurisdiction would prepare its own reconstruction plan, the three plans will need to be coordinated with each other. The three communities share one island, one primary road, and two bridges. The actions of one community will affect conditions in the others. In the event of a hurricane, jurisdictional boundaries will quickly lose their importance as residents and visitors evacuate the island and people return to repair and rebuild damaged properties. Well thought-out and carefully designed reconstruction plans will lessen the chaos, allow people to rebuild reasonably quickly, and require them to rebuild safely.

REFERENCES: CHAPTER 6

John J. Hooton and Associates. 1980. Town of Topsail Beach Coastal Area Management Act Land Use Plan. Topsail Beach, NC: Town of Topsail Beach.

John J. Hooton and Associates. 1981. Town of Surf City Coastal Area Management Act Land Use Plan. Surf City, NC: Town of Surf City.

Onslow County Planning Department. 1981. Onslow County Land Use Plan. Jacksonville, NC: Onslow County Board of Commissioners.

U.S. Army Corps of Engineers - Wilmington District. 1982. Summary of Potential Hurricane Damages on Topsail Island, North Carolina. Wilmington, NC: U.S. Army Corps of Engineers.

CHAPTER 7:

PLANNING FOR RECONSTRUCTION

As an official statement of principles and policies for the community to follow in rebuilding after a hurricane or similar disaster, a reconstruction plan has four purposes:

1. to expedite community recovery by outlining procedures and requirements for repairs and reconstruction before damages occur;

2. to establish a procedural framework for putting hazard mitigation measures into effect after disaster strikes the community and buildings and utilities are being repaired and rebuilt;

3. to gather and analyze information concerning the location and nature of hurricane damages in the community; and

4. to assess the community's vulnerability to hurricane damages and guide reconstruction to minimize this vulnerability.

The plan should outline damage assessment and reconstruction permitting procedures that the community will follow after a disaster occurs. It should identify information that the local government will need to make sound permit decisions regarding repairs and reconstruction and to get state and federal disaster assistance. Some specific topics that the plan should address include:

1. identifying cases where repairs and reconstruction will not be permitted, or will be permitted only if they meet certain conditions;

2. guidelines (drawn from the analysis of hazards and mitigation measures) for the repair and rebuilding of damaged structures and utilities; and

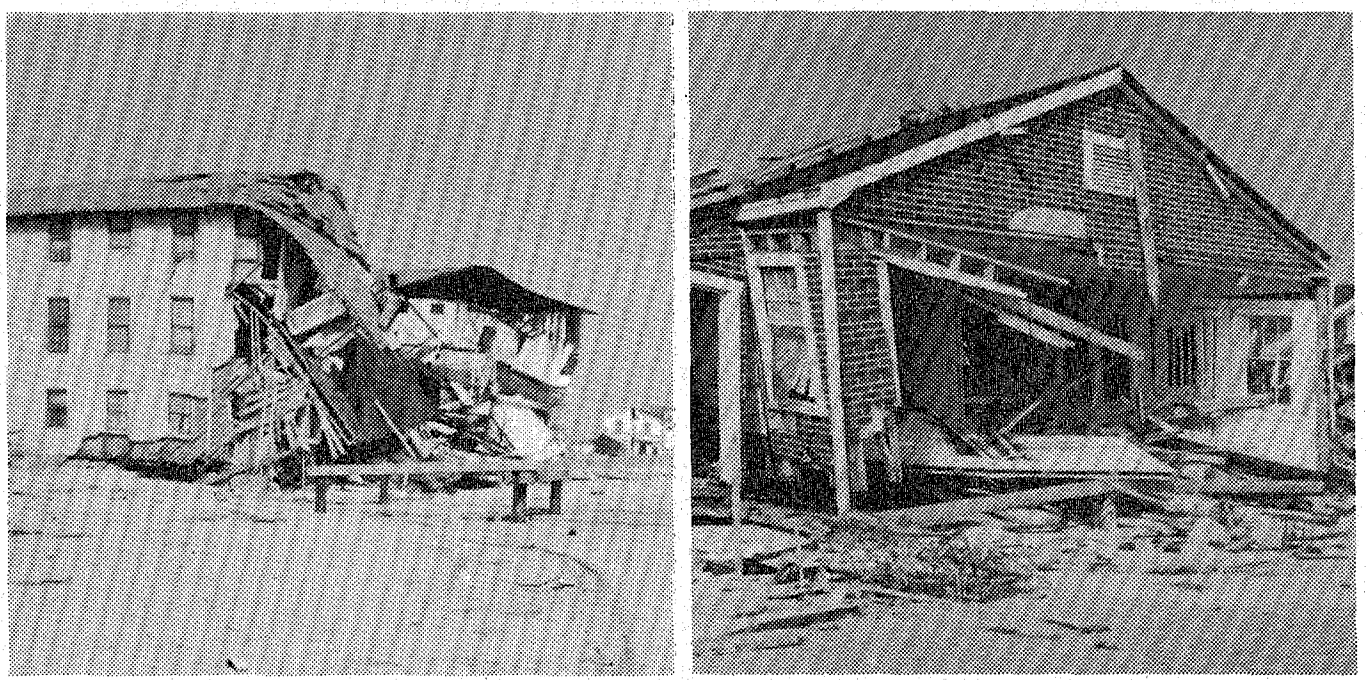
3. plans for possible public acquisition of high hazard areas and the relocation of highly vulnerable and damaged structures.

By identifying and clarifying all of these policies, procedures, and information requirements, local officials will have a ready set of guidelines by which they can make wise and expedient decisions regarding reconstruction. The plan will help avoid delays as well as make the community safer from damages in the long run.

Since it is crucial for local officials to understand federal and state procedures for assessing damages and applying for disaster relief aid, this chapter begins with a discussion of current procedures followed by the Federal Emergency Management Agency, the N.C. Division of Emergency Management, and other federal and state agencies when disaster strikes the community. These procedures provide the context for local recovery activities. While they include specific things that local governments must do to receive federal and

state disaster assistance, they also provide a basis for other actions that local governments can take to implement their own hazard mitigation policies.

After presenting federal and state emergency response procedures, this chapter discusses the local role in disaster recovery and outlines important topics for local governments to cover in establishing post-hurricane damage assessment and reconstruction permitting procedures. These local procedures, which constitute the local reconstruction plan, should be based on carrying out the community's hazard mitigation policies (see Chapter 5) during recovery from a major storm.



This hotel in Wilmington Beach and this house in Carolina Beach were damaged beyond repair by Hurricane Hazel, making damage assessment pretty easy. Most cases aren't as simple. (Courtesy of N. C. Div. of Archives and History)

THE FEDERAL ROLE IN EMERGENCY RESPONSE AND PROCEDURES FOR OBTAINING FEDERAL DISASTER ASSISTANCE

Federal disaster assistance programs are designed to supplement local, state, and private resources when these are insufficient to repair damages and to alleviate hardship in the wake of a major disaster. The various types of federal assistance available were briefly discussed in Chapter 4. The key federal legislation dealing with disasters is the Disaster Relief Act of 1974 (P.L. 93-288), which authorizes a wide range of financial and direct assistance to state and local governments and private individuals. While other legislation has created a number of disaster assistance programs within a variety of federal agencies, the Disaster Relief Act and the regulations adopted to administer it set the guideines and procedures by which federal aid is issued and vests the Federal Emergency Management Agency with primary

responsibility for coordinating and providing disaster relief. FEMA follows a standard set of procedures governing federal responsibilities, damage assessments, applications for assistance, the granting of assistance, and post-disaster hazard mitigation planning.

The Presidential Declaration

FEMA's disaster response procedures are set into motion by a Presidential declaration of "emergency" or "major disaster," as authorized by P.L. 93-288. An "emergency" is any natural disaster which calls for emergency federal assistance to supplement state and local efforts to avert the threat of a disaster or to protect lives, public health, and property. A "major disaster" is one that causes damages of a sufficient severity and magnitude to warrant major federal assistance above and beyond emergency services.

FEMA keeps close track of potential disasters, such as the development and path of a hurricane; it maintains close contact with the Governor's office and the N.C. Division of Emergency Management, as well as other federal agencies responsible for disaster assistance, as the threat increases and disaster strikes. After an initial reconnaissance, local officials in a disaster-stricken community should immediately report the nature and extent of damages to the N.C. Division of Emergency Management (DEM). DEM then advises the Governor on the seriousness of the situation; the Governor may declare a state of emergency, put the state's disaster relief and assistance plan into operation, and direct state resources to where they are needed. If it becomes apparent that the situation is of a severity or magnitude that exceeds state and local capabilities, the Governor can ask the President, via FEMA, to declare an "emergency" or "major disaster." Only the Governor (or Acting Governor) can make this request.

Preliminary Damage Assessment

If the Governor asks for a Presidential declaration, state disaster officials will:

1. survey the affected areas, jointly with local officials and (if possible) FEMA's regional disaster specialists, to determine the extent of damages;

2. estimate the types and extent of federal assistance needed;

3. consult with FEMA's Regional Director regarding eligibility requirements; and

4. advise FEMA's Regional Director of the state's intent to request a Presidential declaration.

The Governor's request for a Presidential declaration will include a certification of reasonable state and local expenditures for disaster relief and an estimate of the federal assistance required for the state and each affected county. The Governor's request, addressed to the President, is submitted to FEMA's Regional Director, who evaluates the estimates of damage and assistance

needs and makes a recommendation to the Director of FEMA. The Director then recommends a course of action to the President, who issues the declaration and sets in motion the machinery for issuing federal disaster assistance to eligible public agencies, individuals, and businesses.

FEMA's Post-disaster Procedures

Once the President declares an "emergency" or "major disaster," the Governor and FEMA's Regional Director sign a Federal-State Disaster Assistance Agreement which specifies where and how federal disaster relief will become available. FEMA's Associate Director for Disaster Response and Recovery designates those counties and municipalities that are eligible for federal disaster assistance and appoints another federal official (usually FEMA's Regional Director) as the Federal Coordinating Officer (FCO). The FCO performs a number of functions:

1. determining the types of assistance most urgently needed;
2. coordinating all federal disaster relief efforts;
3. coordinating federal activities with those of state and local agencies and private disaster relief organizations (such as the Red Cross and the Salvation Army);
4. informing people in the community about the types of assistance available;
5. setting up and operating disaster field offices; and
6. taking other actions, consistent with his authority, to help local citizens and public agencies promptly obtain assistance for which they are eligible.

The FCO is usually supported by one or more deputies who are delegated to perform some of these functions.

FEMA sets up a temporary Disaster Field Office in the stricken area as a base for federal disaster relief operations. The Disaster Field Office is usually located in conjunction with a similar state office operated by the State Coordinating Officer (from the N.C. Division of Emergency Management), who is the primary liaison between the FCO and state and local officials. The location and telephone number of the Disaster Field Office is publicized widely to allow applicants to visit or call when problems arise. The Disaster Field Office is staffed by representatives of FEMA and all other federal agencies with disaster assistance responsibilities in the area. These field representatives are responsible for providing prompt assistance to disaster victims and advising local and state agencies on eligibility requirements, surveying and reporting damages, and applying for federal assistance. In addition to these agency representatives, the FEMA Regional Director may dispatch Emergency Support Teams to provide specialized counseling, to help operate the Disaster Field Office, and to temporarily supplement local and state emergency response and damage assessment efforts.

The types of federal disaster assistance fall into two general categories: individual assistance (for individuals, families, and businesses) and public assistance (for local and state agencies). FEMA disseminates information about available aid programs via local radio, television, newspapers, and pamphlets. FEMA will establish a Disaster Assistance Center in the area to help individual disaster victims more easily get information and guidance from the various federal agencies. FEMA may dispatch mobile teams to help persons in the area who lack easy access to the Disaster Assistance Center. At the center, disaster victims apply for assistance from the various federal programs mentioned in Chapter 4. In addition to operating the Disaster Assistance Center (mainly for providing individual assistance), FEMA and NCDEM personnel hold an applicant briefing for local and state officials to inform them of the public assistance available and the procedures and eligibility requirements involved. Items covered at the briefing include:

1. filing a Notice of Interest in receiving different types of federal disaster assistance;

2. preparing Damage Survey Reports (DSRs) to document damages and present repair costs;

3. filing a Project Application; and

4. addressing special considerations, such as environmental assessments and opportunities for hazard mitigation.

The Notice of Interest (see Figure 7.1) is basically a checklist on which local and state officials identify the types of damage sustained by public facilities. It provides the basis by which FEMA schedules damage surveys.

Damage Survey Reports (see Figure 7.2) document the extent of damages to different facilities, identify needed and eligible repairs, and assess in detail the costs of repairing or rebuilding them. The DSRs are prepared by a Damage Assessment Team consisting of federal, state, and local personnel, and are submitted to FEMA and the N.C. Division of Emergency Management. The DSR is the basis for FEMA's approval of applications for public assistance. The Damage Assessment Team depends on local officials' damage assessments to measure the severity and magnitude of damage; it is therefore very important for the local government to maintain accurate property records and conduct its own damage survey before the Damage Assessment Team arrives (Rogers, Golden, and Halpern, 1981, p. 4-23). Photographs, maps, and drawings are often included in the DSR to provide more complete descriptions and documentation.

FEMA classifies damages that are eligible for public assistance into seven categories of "permanent" work and two categories of "emergency" work (see Table 7.1). A separate DSR is prepared for each category of work and for each damage site; separate DSRs are required for different categories of work at the same site.

A DSR does not constitute an approval of repair work or a commitment of federal funds. It simply provides the most accurate information available on the extent of damages and estimated repair costs, which FEMA uses to approve or deny specific line items requested in the Project Application.

Figure 7.1: FEMA Notice of Interest Form

Form Approved
OMB No. 026-R0036

FEDERAL EMERGENCY MANAGEMENT AGENCY
DISASTER RESPONSE AND RECOVERY

NOTICE OF INTEREST

IN APPLYING FOR FEDERAL DISASTER ASSISTANCE

FEMA DECLARATION NUMBER

DATE

FIPS NUMBER

The purpose of this form is to list the damages to property and facilities so that inspectors may be appropriately assigned for a formal survey.

REQUIREMENTS FOR FEDERAL DAMAGE SURVEYS

A. DEBRIS CLEARANCE

- ☐ On Public Roads & Streets including ROW
- ☐ Other Public Property
- ☐ Private Property *(When undertaken by local Government forces)*
- ☐ Structure Demolition

B. PROTECTIVE MEASURES

- ☐ Life and Safety ☐ Health
- ☐ Property ☐ Stream/Drainage Channels

C. ROAD SYSTEMS

- ☐ Roads ☐ Streets
- ☐ Bridges ☐ Culverts
- ☐ Traffic Control ☐ Other*

D. WATER CONTROL FACILITIES

- ☐ Dikes ☐ Levees ☐ Dams
- ☐ Drainage Channels ☐ Irrigation Works

E. PUBLIC BUILDINGS AND EQUIPMENT

- ☐ Public Buildings
- ☐ Supplies or inventory
- ☐ Vehicles or other equipment
- ☐ Transportation Systems
- ☐ Higher Education Facilities

F. PUBLIC UTILITY SYSTEMS

- ☐ Water ☐ Storm Drainage
- ☐ Sanitary Sewerage ☐ Light/Power
- ☐ Other*

G. FACILITIES UNDER CONSTRUCTION

- ☐ Public Facilities*
- ☐ Private Non-Profit Facilities**

H. PRIVATE NON-PROFIT FACILITIES**

- ☐ Educational ☐ Medical
- ☐ Emergency ☐ Custodial Care
- ☐ Utility

I. OTHER *(Not in above categories)*

- ☐ Park Facilities
- ☐ Recreational Facilities

** Indicate type of facility;*
*** Provide name of the facility and of private non-profit owner.*

NAME AND TITLE OF REPRESENTATIVE WHO WILL ACCOMPANY THE SURVEY TEAM.

NAME OF POLITICAL SUBDIVISION OR ELIGIBLE APPLICANT 1	COUNTY 2
BUSINESS ADDRESS	ZIP CODE
BUSINESS TELEPHONE *(Area Code/Number)* 3	HOME TELEPHONE *(Area Code/Number)*
APPLICANT'S AUTHORIZED REPRESENTATIVE 4	BUSINESS TELEPHONE *(Area Code/Number)*

FEMA FORM 90-40 (3/80)

Source: FEMA, 1981, Handbook for Applicants, p. E-1.

Figure 7.2: FEMA Damage Survey Report Form

Form Approved
OMB No. 3067-0027

FEDERAL EMERGENCY MANAGEMENT AGENCY
DAMAGE SURVEY REPORT
DISASTER RESPONSE AND RECOVERY
(See instructions on reverse)

3. DECLARATION NO. FEMA
4. INSPECTION DATE

1. TO ➡ REGION _____ FEDERAL EMERGENCY MANAGEMENT AGENCY

5. WORK ACCOMPLISHED BY
☐ CONTRACT
☐ FORCE ACCOUNT

2. APPLICANT *(State Agency, County, City, etc.)* | PA NO.

7. WORK CATEGORY *("X" Applicable Box)*
☐ EMERGENCY ☐ A ☐ B
☐ PERMANENT ☐ C ☐ D ☐ E ☐ F ☐ G ☐ H ☐ I

DSR NO. 100001

6. PERCENTAGE OF WORK COMPLETED TO DATE
%

8. DAMAGED FACILITIES *(Location, identification and description)*

8A. FACILITY IN OR AFFECTS FLOOD PLAIN OR WET LANDS
☐ YES ☐ NO

9. DESCRIPTION OF DAMAGE

10. SCOPE OF PROPOSED WORK

11. ESTIMATED COST OF PROPOSED WORK

QUANTITY (a)	UNIT (b)	MATERIAL AND/OR DESCRIPTION (c)	UNIT PRICE (d)	COST *(dollars)* (e)

12. EXISTING INSURANCE *(Type)* | AMOUNT $ | TOTAL ➡ $

13. RECOMMENDATION BY FEDERAL INSPECTOR *(Signature, Agency, date)* | ELIGIBLE ☐ YES ☐ NO | ATTACHMENTS

14. CONCURRENCE IN REPORT BY STATE INSPECTOR *(Signature, Agency, date)* | CONCUR ☐ YES ☐ NO | ATTACHMENTS

15. CONCURRENCE IN REPORT BY LOCAL REPRESENTATIVE *(Signature, Agency, date)* | CONCUR ☐ YES ☐ NO | ATTACHMENTS

16. FEDERAL REVIEW *(Signature, Agency, date)* | FEMA REVIEW *(Initials and date)*

FEMA Form 90-52, JAN 81(Formerly HUD Form 484)

COPY 1 - FEMA REGION

Source: FEMA, 1981, Handbook for Applicants, p. F-1.

Table 7.1: Categories of Public Assistance Available from FEMA

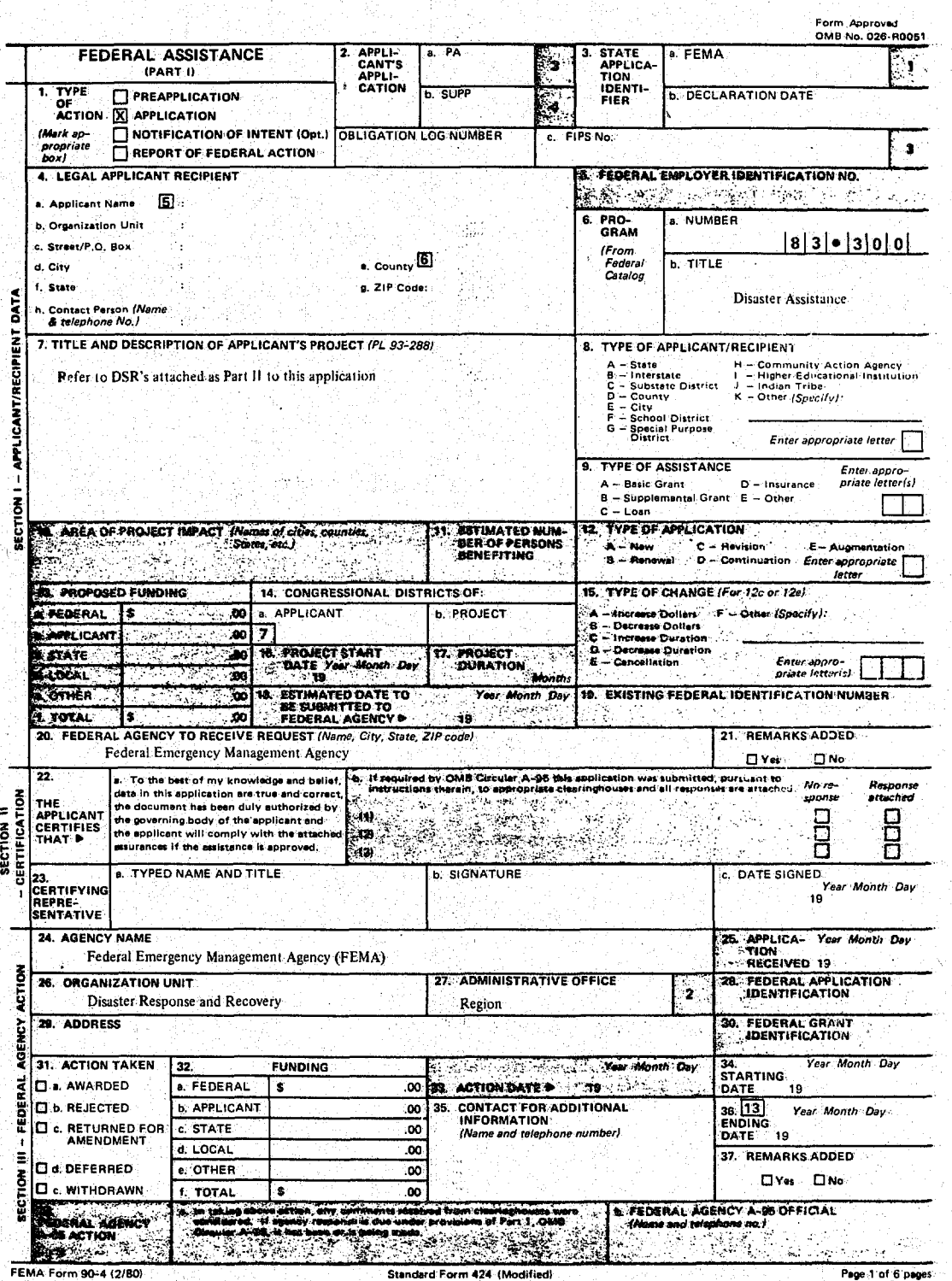
"Emergency" Work	"Permanent" Work
Debris Removal	Road or Street Systems
Emergency Protection (incl. communications and public transportation)	Water Control Facilities
	Public Buildings and Related Equipment
	Public Utilities
	Facilities under Construction
	Private Nonprofit Facilities
	"Other"

The Project Application (see Figure 7.3) is the formal request for aid that a local government or state agency submits to FEMA's Regional Director through the N.C. Division of Emergency Management (or the Governor's Authorized Representative). The Project Application summarizes and combines the Damage Survey Reports for various repair projects for public facilities damaged in the community. The Project Application also provides the formal record of FEMA's and NCDEM's review and approval of the different projects for which federal funds are committed. The Project Application is signed by the applicant's authorized representative and is accompanied by a form designating this representative (see Figure 7.4). The Project Application is also accompanied by the complete Damage Survey Report for each project listed. The application must be submitted to FEMA's Regional Director within 90 days of the Presidential declaration of a "major disaster"; the deadline is 30 days for an "emergency" declaration. Local officials should keep in mind that, under current FEMA policy, the federal government will only fund up to 75 percent of the eligible cost of repairs to public facilities.

Once a Project Application is approved and FEMA makes different forms of public assistance available to the local government or state agency, FEMA maintains standards for project administration. These include project completion deadlines, progress reports, and cost overruns. In a community where an "emergency" has been declared, federal assistance typically ends one month after the initial Presidential declaration. Where a "major disaster" has been declared, federal assistance for "emergency" work typically ends six months after the declaration and federal assistance for "permanent" work ends after 18 months. Recipients of federal disaster aid can receive time extensions for a number of extenuating circumstances. Recipients must submit progress reports if there are any delays that would make a project run past the deadline or if the recipient faces cost overruns. FEMA or other federal and state agencies may conduct periodic inspections of selected projects to make sure that work is progressing in a timely fashion and according to the appropriate standards, policies, and procedures.

As work on a project ends, the recipient notifies the Governor's Authorized Representative, who arranges for federal or state personnel to make a final inspection of the work in each category of funding (i.e. "emergency" or "permanent"). The Final Inspection Report (see Figure 7.5) documents the

Figure 7.3: FEMA Project Application Form



Form Approved
OMB No. 026-R0051

FEDERAL ASSISTANCE (PART I)

2. APPLICANT'S APPLICATION — a. PA [2] — b. SUPP [4]

3. STATE APPLICATION IDENTIFIER — a. FEMA [1] — b. DECLARATION DATE

1. TYPE OF ACTION (Mark appropriate box): [ ] PREAPPLICATION [X] APPLICATION [ ] NOTIFICATION OF INTENT (Opt.) [ ] REPORT OF FEDERAL ACTION

OBLIGATION LOG NUMBER — c. FIPS No. [3]

SECTION I – APPLICANT/RECIPIENT DATA

4. LEGAL APPLICANT RECIPIENT
a. Applicant Name [5]
b. Organization Unit
c. Street/P.O. Box
d. City — e. County [6]
f. State — g. ZIP Code:
h. Contact Person (Name & telephone No.)

5. FEDERAL EMPLOYER IDENTIFICATION NO.

6. PROGRAM (From Federal Catalog) — a. NUMBER 83.300 — b. TITLE: Disaster Assistance

7. TITLE AND DESCRIPTION OF APPLICANT'S PROJECT (PL 93-288)
Refer to DSR's attached as Part II to this application

8. TYPE OF APPLICANT/RECIPIENT
A – State; B – Interstate; C – Substate District; D – County; E – City; F – School District; G – Special Purpose District; H – Community Action Agency; I – Higher Educational Institution; J – Indian Tribe; K – Other (Specify): ____
Enter appropriate letter [ ]

9. TYPE OF ASSISTANCE
A – Basic Grant; B – Supplemental Grant; C – Loan; D – Insurance; E – Other
Enter appropriate letter(s) [ ]

10. AREA OF PROJECT IMPACT (Names of cities, counties, States, etc.)

11. ESTIMATED NUMBER OF PERSONS BENEFITING

12. TYPE OF APPLICATION
A – New; B – Renewal; C – Revision; D – Continuation; E – Augmentation
Enter appropriate letter [ ]

13. PROPOSED FUNDING

a. FEDERAL	$ .00
b. APPLICANT	.00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. TOTAL	$ .00

14. CONGRESSIONAL DISTRICTS OF: a. APPLICANT [7] — b. PROJECT

15. TYPE OF CHANGE (For 12c or 12e)
A – Increase Dollars; B – Decrease Dollars; C – Increase Duration; D – Decrease Duration; E – Cancellation; F – Other (Specify): ____
Enter appropriate letter(s) [ ]

16. PROJECT START DATE (Year Month Day) 19

17. PROJECT DURATION (Months)

18. ESTIMATED DATE TO BE SUBMITTED TO FEDERAL AGENCY (Year Month Day) 19

19. EXISTING FEDERAL IDENTIFICATION NUMBER

20. FEDERAL AGENCY TO RECEIVE REQUEST (Name, City, State, ZIP code)
Federal Emergency Management Agency

21. REMARKS ADDED [ ] Yes [ ] No

SECTION II – CERTIFICATION

22. THE APPLICANT CERTIFIES THAT ▶
a. To the best of my knowledge and belief, data in this application are true and correct, the document has been duly authorized by the governing body of the applicant and the applicant will comply with the attached assurances if the assistance is approved.
b. If required by OMB Circular A-95 this application was submitted, pursuant to instructions therein, to appropriate clearinghouses and all responses are attached. (No response / Response attached)
(1) [ ] [ ]
(2) [ ] [ ]
(3) [ ] [ ]

23. CERTIFYING REPRESENTATIVE — a. TYPED NAME AND TITLE — b. SIGNATURE — c. DATE SIGNED (Year Month Day) 19

SECTION III – FEDERAL AGENCY ACTION

24. AGENCY NAME
Federal Emergency Management Agency (FEMA)

25. APPLICATION RECEIVED (Year Month Day) 19

26. ORGANIZATION UNIT
Disaster Response and Recovery

27. ADMINISTRATIVE OFFICE
Region [2]

28. FEDERAL APPLICATION IDENTIFICATION

29. ADDRESS

30. FEDERAL GRANT IDENTIFICATION

31. ACTION TAKEN
[ ] a. AWARDED
[ ] b. REJECTED
[ ] c. RETURNED FOR AMENDMENT
[ ] d. DEFERRED
[ ] e. WITHDRAWN

32. FUNDING

a. FEDERAL	$ .00
b. APPLICANT	.00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. TOTAL	$ .00

33. ACTION DATE ▶ (Year Month Day) 19

34. STARTING DATE (Year Month Day) 19

35. CONTACT FOR ADDITIONAL INFORMATION (Name and telephone number)

36. [13] ENDING DATE (Year Month Day) 19

37. REMARKS ADDED [ ] Yes [ ] No

FEDERAL AGENCY 95 ACTION — a. In taking above action, any comments received from clearinghouses were considered. If agency response is due under provisions of Part 1, OMB Circular A-95, it has been or is being made.

b. FEDERAL AGENCY A-95 OFFICIAL (Name and telephone no.)

FEMA Form 90-4 (2/80) — Standard Form 424 (Modified) — Page 1 of 6 pages

Source: FEMA, 1981, Handbook for Applicants, p. G-1.

Figure 7.3: FEMA Project Application Form (continued)

39a. **PART I** *(Continued)* FEMA Agreement No. _____ P.A. No. _____ Sup. No. _____

39b. Project Summary *(Based on Part II of this application)*

	AMOUNT REQUESTED BY APPLICANT	AMOUNT APPROVED BY STATE	AMOUNT APPROVED BY FEMA
A. Debris Clearance			
B. Protective Measures			
C. Road Systems			
D. Water Control Facilities			
E. Public Buildings and Equipment			
F. Public Utilities			
G. Facilities Under Construction			
H. Private Nonprofit Facilities			
I. Other Damages *(Not included in above categories)*			
TOTAL			

40. Funding *(please check)*

	APPLICANT REQUEST	STATE APPROVAL	FEMA APPROVAL
Small Project Grant *(In-lieu Contribution)*	☐	☐	☐
Flexible Funding Grant	☐	☐	☐
Advance of Funds	☐	☐	☐
Categorical Grant	☐	☐	☐
Advance of Funds	☐	☐	☐

41. Approved by Governor's Authorized Representative

_____ *(Date Received)* _____ *(Date Approved)* _____ *(Signature)*

42. Approved by FEMA

_____ *(Date Received)* _____ *(Date Approved)* _____ *(Signature)*

43. Remarks *(Reference application Part and Item Number as appropriate. Attach additional sheets when necessary).*

44. **PART II - PROGRAM NARRATIVE**
(Attach Damage Survey Reports (FEMA Form 90-52) to document fully and support this application)

FEMA Form 90-4 (2/80) Page 3 of 6 pages

Figure 7.4: FEMA Applicant's Agent Designation Form

DESIGNATION OF APPLICANT'S AGENT

RESOLUTION

BE IT RESOLVED BY _____ **OF** _____ ,
(Governing Body) *(Public Entity)*

THAT _____ , _____
* *(Name of Incumbent)* *(Official Position)*

OR

_____ , **Governor's Authorized Representative,**
* *(Name of Incumbent)*

is hereby authorized to execute for and in behalf of _____

_____ , **a public entity established under the laws of the State of** _____ ,
this application and to file it in the appropriate State office for the purpose of obtaining certain Federal financial assistance under the Disaster Relief Act (Public Law 288, 93rd Congress) or otherwise available from the President's Disaster Relief Fund.

THAT _____ , **a public entity established under the laws of the State of** _____ , **hereby authorizes its agent to provide to the State and to the Federal Emergency Management Agency (FEMA) for all matters pertaining to such Federal disaster assistance the assurances and agreements printed on the reverse side hereof.**

Passed and approved this _____ **day of** _____ , **19** ____.

_____
(Name and Title)

_____
(Name and Title)

_____
(Name and Title)

CERTIFICATION

I, _____ , **duly appointed and** _____ **of**
(Title)

_____ , **do hereby certify that the above is a true and correct copy of a resolution passed and approved by the** _____ **of** _____
(Governing Body) *(Public Entity)*

on the _____ **day of** _____ , **19** ____.

Date: _____

_____ _____
(Official Position) *(Signature)*

**Name of incumbent need not be provided in those cases where the governing body of the public entity desires to authorize any incumbent of the designated official position to represent it.*

FEMA Form 90-63, MAR 81

Source: FEMA, 1981, Handbook for Applicants, p. H-1.

Figure 7.5: FEMA Final Inspection Report Form

Form Approved
OMB No.
026-R0056

FEDERAL EMERGENCY MANAGEMENT AGENCY
DISASTER RESPONSE AND RECOVERY
FINAL INSPECTION REPORT

DECLARATION NUMBER AND DATE

APPLICATION NO. | SUPPLEMENT NO.

TO: FEDERAL EMERGENCY MANAGEMENT AGENCY REGION

FROM: *(Agency and/or Bureau and Location)*

1. APPLICANT

2. TYPE OF FUNDING: ☐ CATEGORICAL ☐ FLEXIBLE ☐ SMALL PROJECT GRANT

3. INSPECTED WORK

CAT.	ITEM	DATE COMPLETED	DATE INSPECTED	INSURANCE SETTLEMENT	APPROVED PA COST ESTIMATE	REPORTED COST	CONTRACT/ FORCE ACCT.	SCOPE OF WORK *(Report Changes)*

4. INSPECTOR

	STATE		FEDERAL	
	YES	NO	YES	NO
a. Did you personally inspect each item of completed work?				
b. Did you review and utilize applicable Damage Survey Reports?				
c. Did you review and utilize applicable FEMA Engineering Analyses?				
d. Did you review and utilize applicable Applicant's Documentation?				
e. Did you ever make any prior inspections of any of these work items?				

CERTIFICATION

The above item(s) in the project application for the category of work shown has been inspected and certification is hereby made that the work has been completed as approved therein, except as noted above.

FEDERAL INSPECTOR *(Signature and Title) (Federal Agency)*	*(Date)*	FEMA REVIEW
STATE INSPECTOR *(Signature and Title) (State Agency)*	*(Date)*	INITIALS
LOCAL REPRESENTATIVE *(Signature and Title)*	*(Date)*	DATE

FEMA FORM 90-46 (3/80)

Sheet _____ of _____

Source: FEMA, 1981, Handbook for Applicants, p. K-1.

completion of work and is essential to the recipient's being reimbursed for the cost of repairs. A project that does not exceed $10,000 usually does not require a final inspection.

Once the Final Inspection Report is completed and approved, the recipient files a Request for Reimbursement (see Figure 7.6), attaching a listing of completed line items and their costs. This same form can be used to request advance payments as well as reimbursements. It is the final formal claim for the reimbursement of costs for all repair and reconstruction projects eligible and approved under FEMA's disaster assistance program.

Throughout the damage assessment/grant application/project administration/reimbursement process, it is essential for the local government to maintain detailed records. Records pertaining to damage assessment and repair costs should be well organized and contain accurate documentation. Damage Survey Reports should be accompanied by photographs, sketches, and property information (value, ownership, etc.); unsalvageable damaged equipment should even be retained for inspection by survey teams (FEMA, 1981, Documenting Disaster Damage, p. 5). Other records should be maintained to document repair costs that are contracted out or borne by the local government itself; this would include time sheets, equipment use schedules, and invoices should local staff and financial resources be expended for any project. These local expenditures may apply to the 25 percent match required of local and state governments under FEMA's public assistance program. (See FEMA's Documenting Disaster Damage, Report No. DR&R-7, for an excellent, brief discussion of record-keeping requirements and project application procedures).

In addition to funding local repair and reconstruction projects, the federal government may deploy its own personnel and equipment to perform emergency work if local and state personnel and equipment are inadequate to do so. To obtain this "direct" federal assistance, the local government or state agency must submit a request to FEMA's Regional Director, via the Governor's Authorized Representative, within ten days after the Presidential declaration. The request takes the form of a resolution by the local governing body (or body governing a state agency) accompanied by a statement of why the work cannot be conducted with local or state resources. Local government budget constraints are not considered a sufficient cause for receiving direct federal assistance (FEMA, 1981, Handbook for Applicants, p. 5-1). FEMA's Regional Director will either approve or deny the request or, if the requested work falls under the mission of another federal agency, refer the request to that agency.

At the same time that local governments and state agencies are applying for federal disaster assistance, FEMA's Interagency Regional Hazard Mitigation Team conducts its analysis of damages in the community, identifies opportunities for hazard mitigation, and issues its report recommending certain actions for federal, state, and local agencies. Also, FEMA's joint survey team and joint planning team, operating under Section 406 of the Federal Disaster Relief Act, evaluate hazards in the community, recommend specific mitigation measures, and prepare the Section 406 Hazard Mitigation Plan. (See Chapter 4 for more information on the Interagency Teams and Section 406 Plans.)

Figure 7.6: FEMA Request for Reimbursement Form

REQUEST FOR ADVANCE OR REIMBURSEMENT

(See instructions on back)

Approved by Office of Management and Budget, No. 026-R0059

PAGE OF PAGES

1. TYPE OF PAYMENT REQUESTED — a. "X" one, or both boxes: ☐ ADVANCE ☐ REIMBURSEMENT; b. "X" the applicable box: ☐ FINAL ☐ PARTIAL

2. BASIS OF REQUEST: ☐ CASH ☐ ACCRUAL

3. FEDERAL SPONSORING AGENCY AND ORGANIZATIONAL ELEMENT TO WHICH THIS REPORT IS SUBMITTED

4. FEDERAL GRANT OR OTHER IDENTIFYING NUMBER ASSIGNED BY FEDERAL AGENCY

5. PARTIAL PAYMENT REQUEST NUMBER FOR THIS REQUEST

6. EMPLOYER IDENTIFICATION NUMBER

7. RECIPIENT'S ACCOUNT NUMBER OR IDENTIFYING NUMBER

8. PERIOD COVERED BY THIS REQUEST — FROM *(month, day, year)* TO *(month, day, year)*

9. RECIPIENT ORGANIZATION

Name

Number and Street

City, State and ZIP Code:

10. PAYEE *(Where check is to be sent if different than item 9)*

Name

Number and Street

City, State and Zip Code:

11. COMPUTATION OF AMOUNT OF REIMBURSEMENTS/ADVANCES REQUESTED

PROGRAMS/FUNCTIONS/ACTIVITIES		(a)	(b)	(c)	TOTAL
a. Total program outlays to date *(As of date)* *(On apv'd work)*		$	$	$	$
ADVANCE b. *Less:* Cumulative program income *(Prior advances)*					
c. Net program outlays *(Line a minus line b)*					
d. Estimated net cash outlays for advance period *(Next 60 days)*					
e. Total *(Sum of lines c & d)* *(Advance requested)*					
f. Non-Federal share of amount on line c					
g. Federal share *(Total claimed)*					
REIMBURSE h. Federal payments *(Total advanced)*					
i. Federal share now requested *(Line g minus line h)* *(Amount due)*					
j. Advances required by month, when requested by Federal grantor agency for use in making pre-scheduled advances	1st month				
	2nd month				
	3rd month				

12. COMPUTATION FOR ADVANCES ONLY

a. Total amount approved on project application *(SF-424)*	$
b. Total prior plus current advances *(Lines 11b & 11e)*	
c. Percent of approved FEMA Funding *(Line 12b/12a x 100)*	%

13. CERTIFICATION

I certify that to the best of my knowledge and belief the data above are correct and that all outlays were made in accordance with the grant conditions or other agreement and that payment is due and has not been previously requested. All work has (has not) been completed, or a listing of work not completed is attached for final payment only.

SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL — DATE REQUEST SUBMITTED

TYPED OR PRINTED NAME AND TITLE

TELEPHONE — *Area Code* — *Number* — *Extension*

I certify that the amount claimed on this voucher is correct and just and that payment has not been received.

☐ Approved Amount $ _____

☐ Disapproved

(Governor's Authorized Representative) *(Date)*

TO: FEMA NATIONAL OFFICE

☐ Approved Amount $ _____

☐ Disapproved

(Regional Director) *(Date)*

REMARKS

FEMA Use

FEMA Form 90-27 (3/80)

EXCEPTION TO STANDARD FORM 270(10-78)
Approved by NARS 11-80

Source: FEMA, 1981, Handbook for Applicants, p. I-1.

If there is no Presidential declaration, certain types of federal disaster assistance are still made available to the community (see Table 4.4). The procedures for receiving such aid vary, as these programs are administered by separate federal agencies. FEMA plays less of a coordinating function when there is no Presidential declaration.

Figure 7.7 illustrates the timetable under which FEMA's disaster assistance procedures operate. It includes deadlines for damage surveys, project applications, and project completion.

THE STATE ROLE IN EMERGENCY RESPONSE AND PROCEDURES FOR OBTAINING STATE DISASTER ASSISTANCE

The state role in disaster situations is to allocate the state resources needed to cope with a disaster and avert losses of life and property. As with federal disaster assistance efforts, state actions are considered supplementary to local actions and are taken only if local resources are inadequate to deal with the situation. The state does play an active and important role in coordinating federal, state, and local disaster relief efforts. All requests by local governments for federal disaster assistance must go through and be coordinated by the state government to ensure that proper procedures are followed and that assistance reaches the community as quickly as possible.

The lead state agency for disaster preparedness and response is the Division of Emergency Management in the N.C. Department of Crime Control and Public Safety. To coordinate state and local disaster efforts, the Division of Emergency Management has developed and maintains the North Carolina Disaster Relief and Assistance Plan, under authority of the N.C. Civil Preparedness Act (N.C.G.S. Chapter 166). The Plan outlines procedures for the state and local governments to follow in planning for disasters, responding to disasters, and seeking outside assistance.

The stated purpose of the N.C. Disaster Relief and Assistance Plan (NCDRAP) is "to provide direction and guidance to State and local governments for preemergency preparedness, emergency response, and postemergency recovery action" (N.C. Division of Civil Preparedness, 1976, p. 1). The plan sets the procedures and principles for state and local agencies to follow in responding to disaster by:

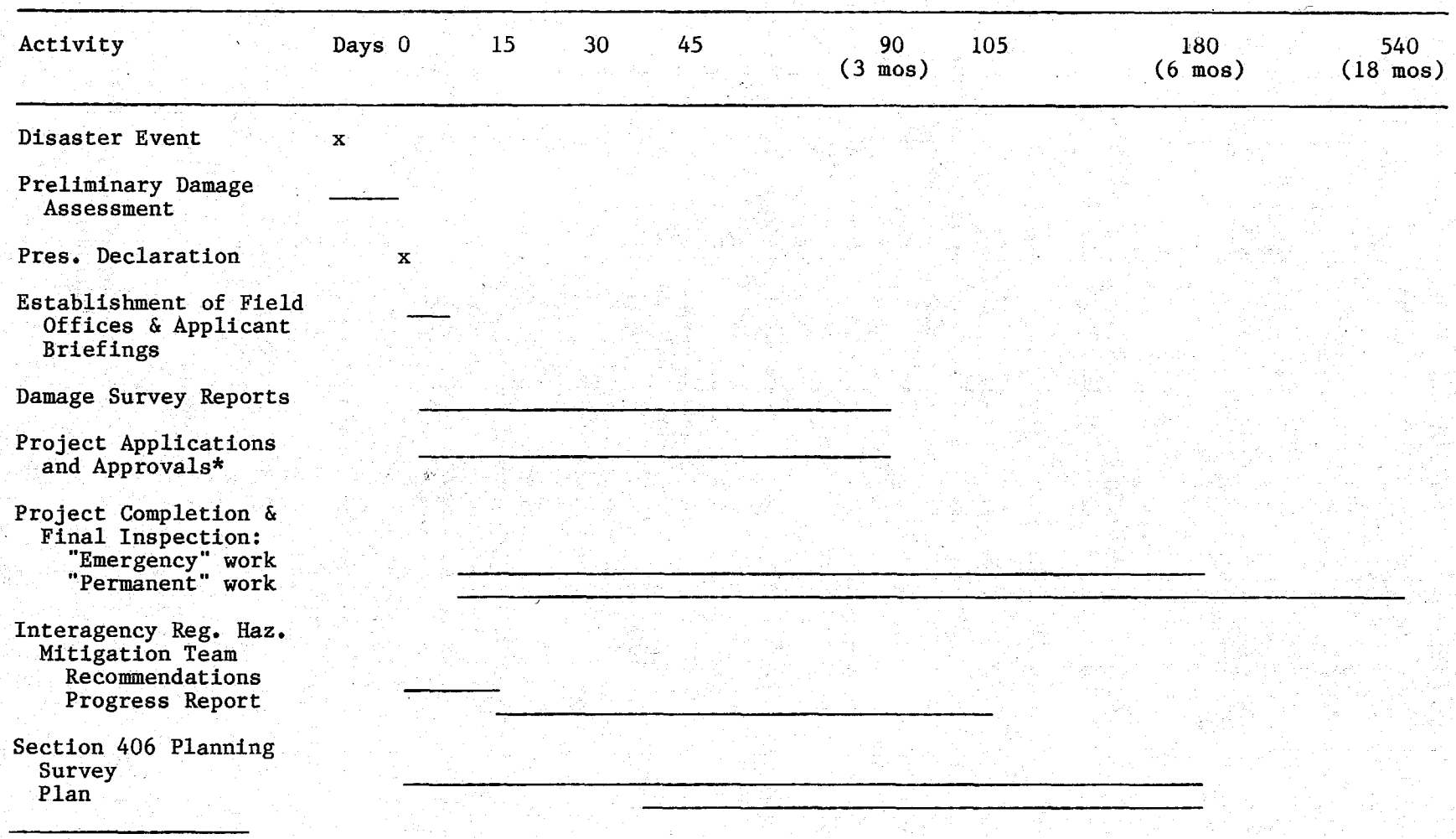
1. defining the roles and responsibilities of state and local officials;

2. defining the emergency-related missions of local governments and state agencies;

3. directing the execution of measures to provide relief and assistance; and

4. outlining forms of recovery assistance available from state and federal agencies and the local actions required to get it.

Figure 7.7: Timing of Federal Disaster Assistance Activities



*Thirty-day deadline if only an "emergency" is declared, not a "major disaster."

Adapted from: FEMA, 1981, Flood Hazard Mitigation: Handbook of Common Procedures, p. I-5.

The NCDRAP identifies four levels of response to an emergency or disaster, each of which entails different levels and types of state involvement. Level A -- Local Response -- applies to those situations that local resources can handle on their own. Level B -- Local Response with State Assistance -- applies to those situations where the local government has declared a "state of emergency" and some assistance is needed from different state agencies to supplement local efforts. Level C -- State of Disaster Response -- applies to those situations that are so severe that they call for a Gubernatorial declaration of a "state of disaster" and a full commitment of state resources. Level D -- Response with Federal Assistance under the Disaster Relief Act -- applies to those situations which state resources cannot handle on their own and which call for a Presidential declaration of disaster and for federal disaster relief. The N.C. Disaster Relief and Assistance Plan is geared to procedures for Levels B, C, and D.

Local governments bear primary responsibility for emergency response within their respective jurisdictions. The four levels of response identified above set up a hierarchy of actions that address disaster situations of different intensities. "Assistance from higher levels of government is obtained by requests from the head of the affected local government to the head of the next higher level of government when (1) local resources are fully committed and found to be inadequate to cope with the situation [and] (2) a particular capability is required and is not locally available" (N.C. Division of Civil Preparedness, 1976, p. 15).

In the event of a disaster, the Governor has overall responsibility for directing state resources to disaster-stricken communities and in requesting federal disaster assistance. The Governor is assisted in this task by the Secretary of the Department of Crime Control and Public Safety, who oversees the Division of Emergency Management. The State Emergency Management Coordinator (the Director of the Division of Emergency Management) coordinates response operations, maintains response and assistance procedures, and guides and assists local and state agencies. (Either the Director of DEM or the Assistant Secretary for Public Safety will serve as the State Coordinating Officer and Governor's Authorized Representative if there is a Presidential declaration.) Area Emergency Management Coordinators monitor state and federal field activities in their respective regions, provide a liaison between local governments and the State EMC, help coordinate the state's response, and provide situation information to the State EMC. The heads of other state departments and agencies carry out their own contingency plans and cooperative agreements, provide assistance at the State Emergency Operating Center, receive functional assignments from the Governor and the State EMC, and direct their own resources, as appropriate, to the community. County Emergency Management Coordinators are the principal operatives at the local government level; it is their responsibility to coordinate all local government activities in their respective counties (including emergency operations, damage assessment and reporting, and requests for state and federal assistance).

The key "command center" for disaster activities is the State Emergency Operating Center (EOC), located at the Division of Emergency Management's Raleigh office. The State EOC is used by the Governor and other state officials to direct and coordinate emergency response activities. A Disaster Field Office (DFO) may be set up in the region during and after a disaster to

facilitate communication between state and local personnel and to expedite the assignment of state resources to different problems. The DFO is staffed by the State Emergency Management Coordinator and other state employees as required for damage surveys, public and individual assistance, and public information. The DFO is usually co-located with the federal Disaster Field Office when there is a Presidential disaster declaration. In addition to the DFO, the state is likely to set up Field Emergency Operating Facilities throughout the damaged region to provide on-the-scene coordination, staff, and equipment. Each county will also have a Local Emergency Operating Center where county and municipal officials direct local response activities and maintain communications with the other state and federal emergency centers.

Requests for state assistance are made to the Governor by the local governing body (see Figure 7.8 for the standard format); the Governor then directs the Division of Emergency Management and other state agencies to provide various types of assistance. Personnel from different state agencies may be called to help in the disaster relief effort by providing specific skills or expertise pertaining to their different departments. Special teams, made up of personnel from several departments, may be called on to address particular problems. State personnel may be called on to help with damage assessment, counselling applicants for state and federal aid, debris removal, and other disaster response and recovery tasks. Figure 7.9 illustrates the chain of command by which the Governor assigns disaster responsibilities to different state agencies.

To the maximum extent feasible, state agencies receive assignments that are closely related to their regular missions. For example, the N.C. Department of Transportation typically plays the primary role in debris removal, especially on public roads. The Division of Health Services (Department of

Figure 7.8: Format for Requesting State Disaster Assistance

REQUEST

Jurisdiction _____(County/Municipality) Date _____

A. Purpose (Statement of need - why the assistance is requested)

B. Type of Assistance (Form of assistance - what assistance is requested)

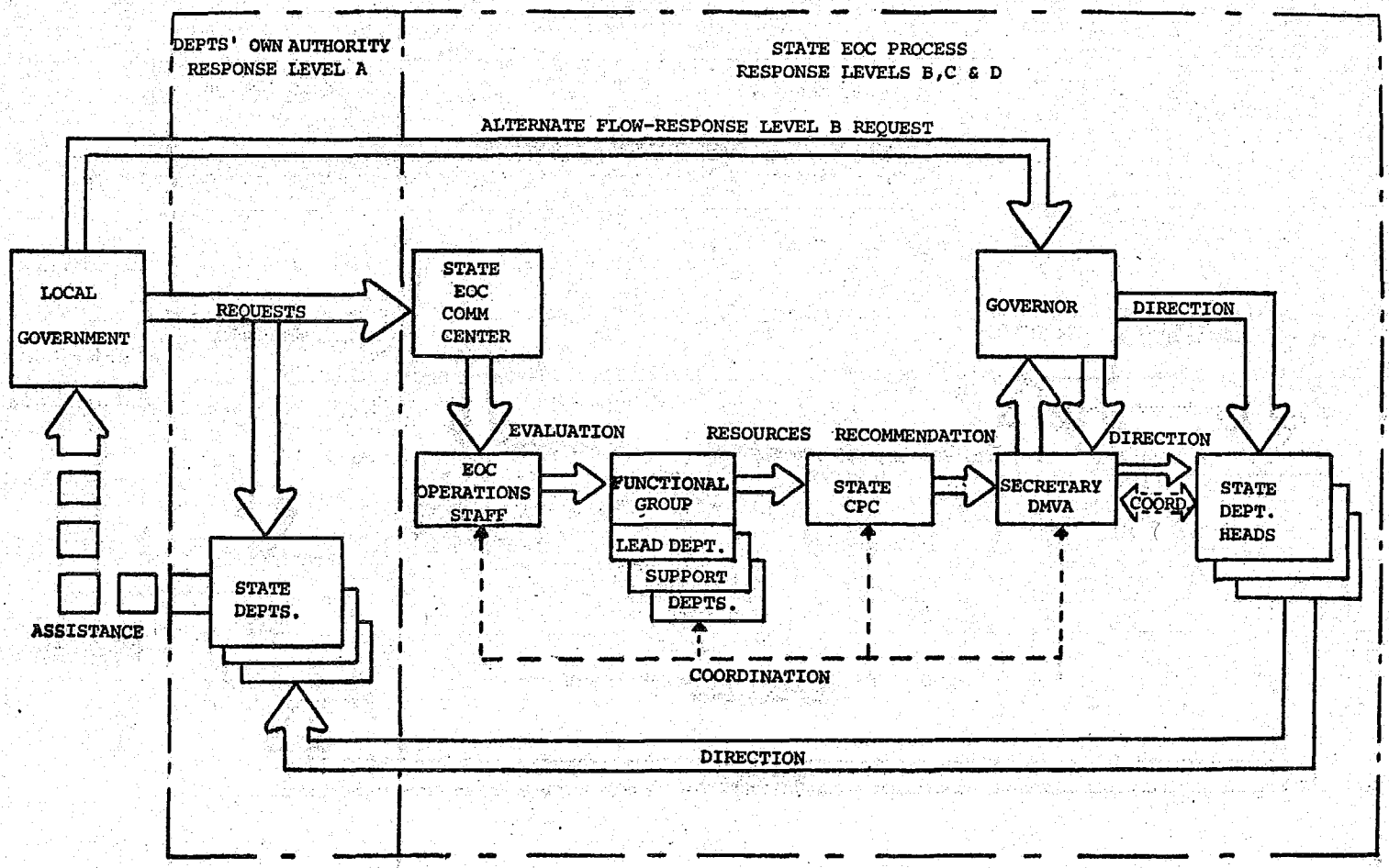
C. Amount (In terms of personnel, material, equipment, facilities and duration - how much assistance)

D. Statement that necessary written clearances, releases, indemnifications have been or will be obtained.

E. Request is made on the authority of _____(Chairman, Mayor, other official) acting for the governing body of the jurisdiction.

Source: N.C. Division of Civil Preparedness, 1976, p. D-I-1.

Figure 7.9: State Assistance Flow Chart



Source: N. C. Division of Civil Preparedness, 1976, p. D-II

Human Resources) will test water supplies and help assess damages to public water systems. Several departments will provide engineering services to help with surveying damages, identifying the feasibility of repairs and safety considerations, and recommending ways to restore essential public services. The Governor can call on the North Carolina National Guard, which can provide communications and transportation, search and rescue, food and water, sanitary and medical services, shelter, property protection, electricity generation, damage assessment, debris clearance, and repair of roads and bridges. The State Emergency Management Coordinator can call on the Civil Air Patrol, which can provide aerial surveillance of surface routes and traffic as well as aerial photography and reconnaissance to aid in damage assessment.

The N.C. Disaster Relief and Assistance Plan outlines local responsibilities for the three phases of disaster activity: the warning phase, the emergency operations phase, and the post-emergency phase (see Table 7.2). The Plan authorizes local governments to:

1. assign employees and equipment for emergency operations;

2. establish local emergency operating centers;

3. establish mutual aid agreements with other local governments and mutual understandings with public and private agencies; and

4. declare a "local state of emergency" which (a) activates any local emergency plans and agreements, and (b) implements provisions of local emergency ordinances. (N.C. Division of Civil Preparedness, 1976, p. 10)

The Plan encourages local governments to prepare local disaster plans which cover:

1. vulnerability analysis;

2. situation reporting and damage assessment procedures;

3. functional assignments for local staff;

4. emergency operation and evacuation procedures;

5. mutual aid agreements and agreements with private agencies; and

6. procedures for requesting assistance from other levels of government. (N.C. Division of Civil Preparedness, 1976, p. 20)

Throughout all phases of disaster activity, the local government must appoint one or more persons to act as chief coordinators of local activities and liaisons with state and federal personnel. The local government must also provide space for federal disaster assistance centers. It must also maintain procedures for accurate reporting, recordkeeping, and accounting to identify and document funds it expended which may be reimbursed by the state and federal governments or may fulfill any match requirements for federal disaster assistance.

Table 7.2: Local Actions During Three Phases of Disaster

WARNING PHASE - increased readiness

1. Establish situation monitoring in local EOC and staff as appropriate. Conduct communications checks.
2. Alert and brief key officials and department personnel.
3. Disseminate appropriate warnings to the public and verify warning effectiveness.
4. Advise utilities, business, and industry.
5. Maintain liaison with local Red Cross and other local relief agencies.
6. If evacuation indicated, insure route marking and shelter designation. Deploy shelter management teams in conjunction with the Red Cross and open shelters for voluntary use when situation indicates.
7. Meet with local news media to review public information policy.
8. Keep the public informed and provide necessary instructions.
9. Keep the State EOC informed and advise adjacent jurisdictions of the situation.
10. Maintain liaison with the Area EMC.
11. Be prepared to proclaim a local "state of emergency" when warranted.

EMERGENCY OPERATIONS PHASE

1. Take necessary measures to protect life and property as conditions permit.
2. Report situation to State EOC and maintain liaison with Area EMC.
3. Maintain contact with adjoining jurisdictions and provide information on own situation to the extent practicable.
4. Based on own capability and severity of the situation, activate mutual aid agreements.
5. If situation is beyond local capabilities, request assistance from next higher level of government.
6. Keep situation reports and damage assessments current and establish priorities for repair and restoration of essential services.
7. Keep public informed and provide instructions.
8. Proclaim a local "State of Emergency" if warranted.

POST-EMERGENCY PHASE - immediate recovery and rehabilitation

1. Continue emergency operations as necessary.
2. Evaluate situation from reports received and initiate damage assessment. Use photography to the extent feasible.
3. Determine requirements for outside assistance and request such assistance when beyond local capabilities.
4. Keep the State EOC and Area EMC informed using Situation and Damage Reports.
5. Keep the public informed and provide instructions.
6. Assemble and maintain records of actions taken and expenditures and obligations incurred.
7. Proclaim a local "state of emergency" if warranted.
8. Commence cleanup, debris removal and utility restoration. Coordinate and facilitate restoration by private utility companies.
9. Undertake repair and restoration of essential public facilities and services in accordance with priorities developed through the situation evaluations.

Source: N.C. Division of Civil Preparedness, 1976, pp. 25-27.

In requesting and receiving state assistance, the local government must file a series of three reports: the Situation Report, the Damage Assessment Report, and the Expenditure/Obligation Report.

County and municipal governments submit initial Situation Reports to the State EOC immediately upon the threat or occurrence of a disaster. Follow-up reports may be submitted or requested as the situation develops. The Situation Report contains any information and preliminary assessments which local officials deem are appropriate to let the state know the severity and magnitude of the situation and what types of assistance the community might need. The Situation Report follows the form shown in Figure 7.10.

The Damage Assessment Report is submitted by the county government no later than 48 hours after the disaster event. While the county government and any municipal governments in the county individually assess damages in their respective jurisdictions, the county government is responsible for consolidating all data for the entire county into one Damage Assessment Report. If a local government wants state assistance, the county transmits the report to the State EOC and the Area Emergency Management Coordinator. The Damage Assessment Report groups damages by property ownership and use according to the following:

1. public property -- state, local, and private non-profit; and
2. private property -- agricultural, residential, and business/industrial.

The report presents damages for each category in:

1. total number of properties;
2. degree of damage (destroyed, major, minor); and
3. total dollar losses (as best estimates).

The Damage Assessment Report follows the form shown in Figure 7.11. The State EOC uses it to determine what types of assistance to provide to the community.

The Expenditure/Obligation Report is submitted by the county government to the State EOC at the state's request. The report presents data for the entire county (municipalities included). It presents the extent of local response in financial terms, including that "local commitment" for which no reimbursement will be requested and which can be used to meet any state or federal match requirements. The Expenditure/Obligation Report follows the form shown in Figure 7.12. The N.C. Disaster Relief and Assistance Plan stresses that local governments must keep "records of actions taken and expenditures and obligations of funds . . . from the outset despite the stress and urgency of an emergency situation" (N.C. Division of Civil Preparedness, 1976, p. C-1). Local records will be subject to state and federal audits if the local government receives outside disaster assistance. Once the Expenditure/Obligation Report is approved by the state, the local government can be reimbursed or credited for its expenditures.

Figure 7.10: DEM Situation Report Form

SITUATION REPORT

Number _____ Date _____

Section A. Description

1. Name of political subdivision (county, city, town)
2. Time and date(s) of occurrence
3. Type(s) of destructive force(s) (tornado, flood, etc.)
4. Deaths and injuries which have resulted
5. General description of damage (adjective description of damages to homes, mobile homes, public facilities, utilities, industry, agriculture, etc.)

Section B. Individuals

1. CASUALTIES: dead, missing, injured, sick
2. EVACUEES: Number evacuated and number aged or requiring special care
3. UNEMPLOYED: Number who may be unemployed and an estimate of the duration of unemployment

Section C. Actions Taken or Pending/Resources Used (personnel, material, facilities)

1. WARNING
2. PUBLIC INFORMATION
3. EVACUATION
4. SHELTER
5. FOOD AND CLOTHING
6. MEDICAL SERVICES
7. HEALTH SERVICES
8. SEARCH AND RESCUE
9. PROTECTIVE MEASURES
10. DEBRIS REMOVAL
11. EMERGENCY REPAIRS
12. TEMPORARY HOUSING
13. TRANSPORTATION
14. COMMUNICATIONS
15. OTHER

Section D. Assistance Which Has Been Requested

1. Mutual Aid Assistance
2. Quasi-governmental and relief agencies (Red Cross, Salvation Army, etc.)
3. State agencies
4. Federal agencies
5. Other

Section E. Agriculture

1. Situation (In terms of acreage, crops, facilities, livestock and poultry affected).
2. Actions (being taken and by whom).
3. Assistance which has been requested and response to such requests.

Section F. Remarks

1. Additional information as necessary including urgent requirements, or responses to specific requests for information, not otherwise provided above.
2. Additional considerations which support the necessity for State or Federal assistance (Previous disasters, etc. to include statement of the economic impact of this disaster on the community).

Source: N. C. Division of Civil Preparedness, 1976, pp. C-I-2 to C-I-3.

Figure 7.11: DEM Damage Assessment Report Form

DAMAGE ASSESSMENT REPORT

County _____ Number _____ Date _____

Section A. Private Property - Nonagriculture

TYPE PROPERTY	NUMBER DESTROYED	NUMBER MAJOR DAMAGE	NUMBER MINOR DAMAGE	TOTAL DOLLAR LOSS	DOLLAR LOSS COVERED BY INSURANCE
1. Houses					
2. Mobile Homes					
3. Multiple Dwelling Units					
4. Businesses					
5. Utilities					
6. Other (Specify)					

Section B. Private Property - Agriculture

TYPE PROPERTY	NUMBER DESTROYED	NUMBER MAJOR DAMAGE	NUMBER MINOR DAMAGE	TOTAL DOLLAR LOSS	DOLLAR LOSS COVERED BY INSURANCE
1. Houses					
2. Mobile Homes					
3. Farm Buildings					
4. Equipment					
5. Livestock					
6. Poultry					
7. Timber					
8. Crops					
9. Farm Fencing					
10. Other (Specify)					

Section C. Public Property (including private nonprofit facilities)

TYPE PROPERTY	NUMBER DESTROYED	NUMBER MAJOR DAMAGE	NUMBER MINOR DAMAGE	TOTAL DOLLAR LOSS	DOLLAR LOSS COVERED BY INSURANCE
1. Buildings					
2. Utility Systems					See Note f
3. Drainage Facilities					NA
4. Levees/Dikes					NA
5. Irrigation Works					NA
6. Municipal Streets					NA
7. Bridges and Culverts					NA
8. Equipment					
9. Communications					
10. Public Transportation					
11. Schools					
12. Other (Specify)					

NOTES:
a) "DESTROYED" - indicates replacement required.
b) "MAJOR DAMAGE" - extensive repairs required, cannot be used until repaired or a home is uninhabitable.
c) "MINOR DAMAGE" - damaged but usable or operable, a dwelling is habitable.
d) "TOTAL DOLLAR LOSS" - in terms of replacement/repair costs at current prices and current standards.
e) "DOLLAR LOSS COVERED BY INSURANCE" - estimate of the dollar loss covered by insurance by type of property, e.g. houses in an affected area average 50% coverage; therefore, the entry on that line would be one-half of the total dollar loss.
f) Utility distribution systems are not normally insurable.
g) NA - indicates Not Applicable.

Source: N. C. Division of Civil Preparedness, 1976, pp. C-I-5 to C-I-6.

Figure 7.12: DEM Expenditure/Obligation Report Form

EXPENDITURE/OBLIGATION REPORT

Date _____

		EXPENDED/ OBLIGATED	LOCAL COMMITMENT
Section A.	Debris Clearance		
	1. Public roads/streets and right of way		
	2. Other Public Property		
	3. Private Property (in the public interest)		
	4. Within Channels		
Section B.	Protective Measures		
	1. Flood fighting		
	2. Emergency health measures and vector control		
	3. Demolition of unsafe structures		
	4. Warning of further risks and hazards		
Section C.	Road Systems		
	1. Municipal streets and roads		
	2. Detours and bypasses		
	3. Bridges and culverts		
	4. Traffic control		
Section D.	Water Control Facilities		
	1. Dykes and levees		
	2. Dams		
	3. Drainage Channels		
	4. Irrigation Works		
Section E.	Public Buildings and Equipment		
	1. Public buildings including schools and higher education facilities (including rental of alternate space)		
	2. Supplies and inventory		
	3. Vehicles and other equipment		
Section F.	Government Owned Utilities		
	1. Water System		
	2. Sewage System		
	3. Storm Drainage System		
	4. Power/Light System		
	5. Communication System		
Section G.	Public Safety		
	1. Search and Rescue		
	2. Fire Fighting		
	3. Law Enforcement		
	4. Security and Protection		
Section H.	Private Nonprofit Facilities		
	1. Buildings and Structures		
	2. Supplies and Equipment		
Section I.	Mass Care		
	1. Shelter		
	2. Food and water		
	3. Medical		
	4. Clothing		
	5. Mortuary Services		
Section J.	Transportation		
	1. Own Equipment		
	2. Rental and Contract		
Section K.	Temporary Housing		
	1. Dwelling Provided		
	2. Rental Spaces		
	3. Site preparation and utility connections		
Section L.	Other Expenditures and Obligations		
	(Specify)		
	TOTALS	EXPENDED/ OBLIGATED	LOCAL COMMITMENT

Source: N. C. Division of Civil Preparedness, 1976, pp. C-I-8 to C-I-10.

THE LOCAL ROLE IN EMERGENCY RESPONSE

Judging from the discussion above, it is apparent that state and federal policies call for local governments to bear the ultimate responsibility for emergency operations, assessing and reporting damages, requesting outside assistance, and managing reconstruction. While state and federal agencies set the procedures for granting assistance to a disaster-stricken community, such assistance will not be available unless local government acts properly and quickly according to state and federal guidelines. In a disaster situation, the local government can expect to commit all of its resources to different response and recovery activities.

To help local governments cope with this task, the N.C. Disaster Relief and Assistance Plan calls for local governments in the state to prepare their own disaster relief and assistance plans. These plans are to outline the responsibilities of local officials during disaster response and recovery and to outline procedures for various emergency activities, damage assessment, disaster assistance centers, and public information. To aid local governments in developing such plans, the N.C. Division of Emergency Management has written a Carolina County Prototype Disaster Relief and Assistance Plan (N.C. Division of Emergency Management, 1981). The prototype plan applies to all disasters (from tornadoes to nuclear reactor accidents) and must be tailored by the local government to fit its individual geography, governmental organization, and hazards.

The prototype plan is primarily geared toward:

1. the assignment of local staff responsibilities during the emergency preparation and response stages;
2. identifying communications and warning systems;
3. setting up emergency shelters and moving people to them;
4. establishing damage assessment procedures;
5. setting up disaster assistance centers; and
6. providing information to the public about the extent of damages and available assistance.

The prototype plan does not deal with reconstruction policy and decisions, or permitting procedures.

The prototype plan contains a number of "annexes" which address different tasks related to emergency response. Annex A contains a model ordinance for setting up basic civil preparedness functions within the local government, a model mutual aid agreement between the local government and other jurisdictions, and model agreements between the local government and the American National Red Cross. Annexes C and D outline a basic set of procedures for communication and warning systems. Annex E identifies emergency shelters and procedures for transporting, registering, feeding, and bunking persons using them. Annex G designates the Disaster Assistance Center, outines DAC procedures, and identifies the responsibilities of federal, state, and local

personnel as well as personnel from private relief organizations. Annex I sets up a plan for temporary housing which identifies available housing units (such as hotel spaces, private rental properties, and government-provided trailers), sites appropriate for temporary mobile homes, and the responsibilities of federal, state, and local personnel.

The section of the prototype plan most relevant to local reconstruction decisions is Annex F -- the Damage Assessment Plan -- which assigns responsibilities and provides instructions for on-the-scene damage surveys. These procedures are designed to be consistent with state and federal requirements for reporting damages to receive state and federal assistance. The annex establishes the responsibilities of the county's Emergency Management Coordinator, Damage Assessment Officer, and damage assessment teams. The annex also calls for designating damage assessment teams before the disaster strikes so people know their responsibilities and are prepared to act. The annex also suggests the types of persons which could be used for damage assessment (see Table 7.3). The annex provides sample worksheets which the teams can use to assess damages by one of two methods: the "direct dollar estimate method" and the "percentage of value method" (see Figures 7.13 and 7.14). The annex also outlines procedures for filing Damage Assessment Reports with the state. The procedures break damages into four categories:

1. destroyed (repairs costing more than 80 percent of value);
2. major (repairs more than 30 percent of value);
3. minor (repairs less than 30 percent which render the structure uninhabitable); and
4. habitable (repairs less than 15 percent of value).

Table 7.3: Prototype Damage Assessment Teams

Public Property Survey Team (Direct Dollar Method)	Business and Industry Survey Team (Percentage of Value Method)
Building and Grounds Engineer	Tax Supervisor
Parks Dept. Representative	Building Inspector
Architect	Realtor
Building Code Officer	Fireman

Private Dwellings Survey Team (Direct Dollar Method)	(Percentage of Value Method)
Building Contractor	Tax Supervisor
Civil Engineer	Realtor
Realtor	Fireman
Architect	

Source: N.C. Division of Emergency Management, 1981, p. F-1-1.

Figure 7.13: Damage Assessment Worksheet (Direct Dollar Estimate)

Damage Assessment Worksheet
(Direct Dollar Estimate Method)

Incident	Area Covered	Date of Insp.
Assessor		Snt. No. / Of

	Property Address	Name of Owner	Bldg. Type	Damage Code	Description of Damage	Estimated Dollar Loss	% Insurance Coverage
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							
16.							
17.							
18.							
19.							
20.							
21.							
22.							
23.							
24.							
25.							

Building Type Code: R-Residence M-Mobile Home B-Business P-Public N-Nonprofit S-School

Damage Code: 1. Habitable 2. Minor (Uninhabitable) 3. Major (Uninhabitable) 4. Destroyed

Remarks: (Continue on reverse if necessary.)

form EM - 38
9 - 81

Source: N.C. Division of Emergency Management, 1981, p. F-5-1.

Figure 7.14: Damage Assessment Worksheet (Percentage of Value Method)

Property Address	Name of Owner	Check (√) Type of Building				Check (√) Extent of Damage				For Use By Damage Assessment Officer		
						Unusable/Uninhabitable			Usable/ Habitable			
		Residence[1]	Mobile Home	Business	Other[2]	Destroyed or Essentially Destroyed, Small Percentage of Structure Remains Intact, or Flood Water Line 6 Feet Above Floor. (x 1.00)	Extensive Exterior and Interior Damage, Portions of Roof or Walls Destroyed, or Flood Water Line 6 Feet Above Floor. (x 0.70)	Damage to Exterior and Interior of Such Magnitude to Render Building Unusable, or Flood Water Line 3 Feet Above Floor. (x 0.30)	Mostly Exterior Surface Damage, Broken Window Glass, etc. Building is Usable. Flood Water Line Above Floor. (x 0.10).	Value of Building (Exclusive of Land, Contents)	Estimated Dollar Loss	% Insurance Coverage
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												
9.												
10.												
11.												
12.												
13.												
14.												
15.												
16.												
17.												
18.												
19.												
20.												

Notes:
1. Check if single family, enter number of families if multi-family, duplex, or apartments.
2. Check and describe on reverse side of form.
3. Use reverse for notes, sketch maps, etc.

Damage Assessment Worksheet
(Percentage of Value Method)

Incident | Area/Zone | Date of Insp.

Assessor | Sht. No. | Of

form EM-39 9-81

Source: N. C. Division of Emergency Management, 1981, p. F-6-1.

While the local Disaster Relief and Assistance Plan outlines procedures for damage assessment, it does not go to the extra step and determine how repairs and reconstruction in the community will proceed. It provides no avenues for making the community safer from the next disaster. Local governments along the North Carolina coast need to establish damage assessment procedures to be prepared for a hurricane or other major storm; they also need to integrate these procedures (1) with current policies governing repairs and reconstruction and (2) with procedures for permitting reconstruction and requiring reconstruction to include features that protect against future damages. The following section outlines a process that local governments can use to plan for reconstruction.

ESTABLISHING POST-HURRICANE DAMAGE ASSESSMENT AND RECONSTRUCTION PERMITTING PROCEDURES

The planning process described in Chapter 5 helps a local government evaluate storm hazards in the community and determine appropriate policies for hazard mitigation and reconstruction. Recall that the process involved six steps:

1. mapping hazard areas;
2. vulnerability assessment;
3. identifying mitigation needs;
4. reviewing current mitigation measures;
5. reviewing alternative measures; and
6. implementation and monitoring.

The process leads to the adoption of policies to reasonably protect new development from storm damages and to ensure that reconstruction leaves the community safer from damage than it was before. The policies can be achieved through a variety of techniques available to local government, from zoning to relocation (see Chapter 4). These hazard mitigation policies and programs should form the basis for local damage assessment activities and reconstruction permitting decisions.

Establishing Damage Assessment Procedures

Local damage assessment procedures should be designed (1) to comply with the documentation requirements of state and federal disaster assistance programs, and (2) to indicate, according to local hazard mitigation policies, which structures may be repaired or rebuilt with no changes, may be repaired or rebuilt with structural changes, or may not be rebuilt at the same site. The damage assessment procedures established for state and federal emergency management programs provide the basis for local damage assessments. The key to these procedures is speed; to avoid delays in receiving outside disaster

assistance and in rebuilding the community, the local government needs to be prepared before the storm to act quickly after it.

Damage assessment procedures require a damage classification scheme which categorizes damages into different levels (such as habitable, minor, major, and destroyed). At a minimum, the local damage classification scheme will need to be consistent with the guidelines set forth by state and federal disaster programs (which define different damage categories by different "percentage of value" figures and which classify damaged facilities as residential, commercial, and public). In addition to meeting state and federal guidelines, local governments should set up their own damage categories based on local hazard mitigation and reconstruction policies. For example, if the local zoning ordinance requires non-conforming structures to meet current standards after being damaged beyond 50 percent, then the local government may want to identify "major" damages as those exceeding 50 percent. Perhaps a zoning permit or other permit would be required for such "major" repairs. Local governments need to list any such levels of damages which require a permit for repairs or invoke a set of standards for those repairs to meet. Such a list, or damage classification scheme, could accompany the damage assessment forms required by state and federal disaster programs. It could be used by damage assessment teams to identify those structures or facilities subject to local repair and reconstruction standards as they make their structure-by-structure inventories of damages in the community.

It is a good idea for local governments to designate damage assessment teams before a storm strikes the community, saving time in the wake of a disaster. Different teams could be assigned to different sections of the community and/or different types of facilities (residential, commercial, and public). A team assessing residential and commercial damages could include a building inspector, a tax supervisor, a building contractor, an architect/engineer, a realtor, and a fireman. A team assessing damages to public facilities could include a public works supervisor, an engineer/architect, and other related personnel. (See Table 7.3 for model assessment teams set forth in the Division of Emergency Management's Carolina County Prototype Disaster Relief and Assistance Plan.) Each damage assessment team should include individuals who are qualified to give reliable estimates of the original value of the structure and the value of damages sustained, as well as to identify the cause of damages (flooding, winds, erosion, or battering) and what repairs are needed to bring the structure up to the required standards.

The local government should identify a set of procedures for putting the damage assessment teams and damage classification scheme into action. These procedures should follow those set up by state and federal disaster programs and local disaster relief and assistance plans. As the teams are deployed and making their rounds in the community, they should:

1. identify those structures that must be demolished or that require a development permit before being repaired or rebuilt;

2. identify, for each damaged structure, the cause of damages; and

3. identify repairs needed for individual private and public facilities.

This information can be translated onto property tax maps to readily identify those areas where repairs and reconstruction must meet certain requirements. When the damage assessment is completed, the damage assessment team could fill out a form identifying the level of damages sustained, or damage classification, of each property and any special requirements for repairs and reconstruction; the form could then be mailed or otherwise delivered to the property owner. The form could include any other information the property owner should know regarding recovery procedures (such as permit requirements, filing deadlines, and public meeting dates).

Establishing Reconstruction Permitting Procedures

For those structures suffering substantial damages or which must be repaired in conformance with current local development standards, the local government must have on hand a well-defined set of procedures for reviewing permit applications, issuing permits in accordance with local hazard mitigation policies, and inspecting repair work. Except for the number of permits which would have to be processed in the wake of a major disaster, these procedures should be essentially the same as the community's normal development permit procedures.

There are some things the local government can do to streamline permit procedures and handle a large number of applications quickly and effectively. Having the damage assessment teams identify, as part of their initial reconnaissance, what repairs are necessary for individual properties to meet local development standards will give the local government ready information on the conditions required for permit approval. For damaged structures which met all local standards before the storm, the local government might want to automatically issue permits to rebuild or repair the structures to their original condition.

The timing of permitting decisions during reconstruction is especially important. The local government may have certain time periods required for public review and comment on permit applications before it can issue a permit. If these time requirements are too long, the public will feel that reconstruction is being unnecessarily delayed and may try to circumvent local development regulations in order to repair or rebuild structures.

The local government may want to coordinate its reconstruction permitting procedures with a list of priorities for repair and reconstruction. For example, the local government may want to prohibit rebuilding and significant repairs in a particular section of the community until essential service facilities (such as electricity, water, and sewer) can be repaired or replaced. The local government can establish such priorities before a disaster occurs so it can concentrate on other problems after a storm hits and expedite reconstruction decisions. Essential public services need to be re-established as quickly as possible; private reconstruction efforts could easily hamper utility repairs (with problems such as people rebuilding driveways over water lines which may have to be torn out and replaced). Less crucial services (such as schools and recreation facilities) can be repaired after essential services are back on line and reconstruction is well underway.

Just as local government can establish priorities for restoring public services, it can also establish priorities for private repairs. For example, the local government may allow property owners suffering minor damages to begin repairs immediately, while those suffering heavier damages must wait a short while to obtain the necessary permits and, if desired, negotiate any relocations of structures. Staging recovery in this way allows some people to make progress immediately, setting the community on the road to recovery.

Adopting temporary development moratoria can greatly aid in community recovery by allowing different activities (such as damage assessment and public facility repairs) to proceed unobstructed and by allowing the local government to stage its reconstruction decisions.

The local government could adopt a temporary moratorium on all repairs until the full damage assessment is completed, which in no case should take longer than five to seven days; certain minor repairs could be exempt from this moratorium (such as replacing windows and the like). After the assessment is finished, the moratorium could be lifted for all properties classified as receiving "minor" damages but remain in place for all properties classified as recieving "major" damages. The moratorium on "major" repairs could be lifted for individual properties as their owners receive the necessary permits; it could also remain in place for several weeks, until local officials can formally reassess hazards in the community and, if they want to, amend hazard mitigation policies based on the type and extent of damages suffered.

The local government could also adopt a temporary moratorium on all new development for a specified period of time. This would let the local government deal with more pressing community recovery and reconstruction permitting problems without devoting its resources to reviewing new development proposals. It also could give the local government time to amend its hazard mitigation policies before allowing any new development to occur, thus ensuring that new development is reasonably safe from future damages.

The local government might also consider appointing a "recovery task force" to oversee the reconstruction process and work on any policy questions that might arise. The recovery task force could be useful in working with state and federal representatives on the Interagency Regional Hazard Mitigation Team and the Section 406 Hazard Mitigation Survey and Planning Teams (see Chapter 4). Like these joint federal/state/local teams, the task force could review the nature of damages in the community, identify and evaluate alternative approaches for repairs and reconstruction, and formulate their own recommendations for handling community recovery. The task force's efforts could lend valuable information and guidance to state and federal efforts and ensure a strong local voice in decisions regarding state and federal disaster assistance. The recovery task force could be formally designated in advance of the disaster and composed of whatever individuals the local government thinks are appropriate. It could consist of only planning board members and local commissioners, or it could include other members of the general public and key local employees (such as the town or county manager, public works supervisor, or building inspector). The task force could be given any number of duties; however, the authority to approve or deny permits for repairs and reconstruction should remain with the group that

normally handles development decisions (that is, the local commission, planning board, or board of adjustments).

The Sequence of Events, or Timetable, for Assessing Damages and Permitting Reconstruction

It is not possible to firmly fix a time schedule for local recovery decisions in advance of a storm; the amount of time it takes to assess damages and make reconstruction decisions will depend on the level of damage the community suffers. However, it is possible to establish the sequence of events the community should follow in assessing damages and permitting repairs and reconstruction. This allows the community to see the various steps it must carry out and develop a rough idea of the amount of time each step takes in relation to the others.

Figure 7.15 outlines the sequence of different local government activities described in previous sections of this chapter. The two most critical events are:

1. the timely completion of damage assessments (to receive state and federal disaster relief and to identify which properties are subject to particular local hazard mitigation requirements); and

2. the imposition of development moratoria (or some similar measure to stage permit decisions and place firm control over repairs and rebuilding).

These provide the lynchpins of the community reconstruction effort. The timely completion of damage assessments (which should take no longer than one week) will set the community on the road to recovery as soon as possible. The development moratoria and permit requirements will allow the local government to stage reconstruction activities and ensure that repairs and reconstruction will leave the community safer from the next storm.

The sequence of events includes a decision on setting a calendar of milestones for reconstruction permitting decisions to meet. This places specific deadlines on each event. These milestones can be set once damages are assessed and the local government has a better idea of the tasks at hand and the amount of time and staff resources needed to carry out these tasks.

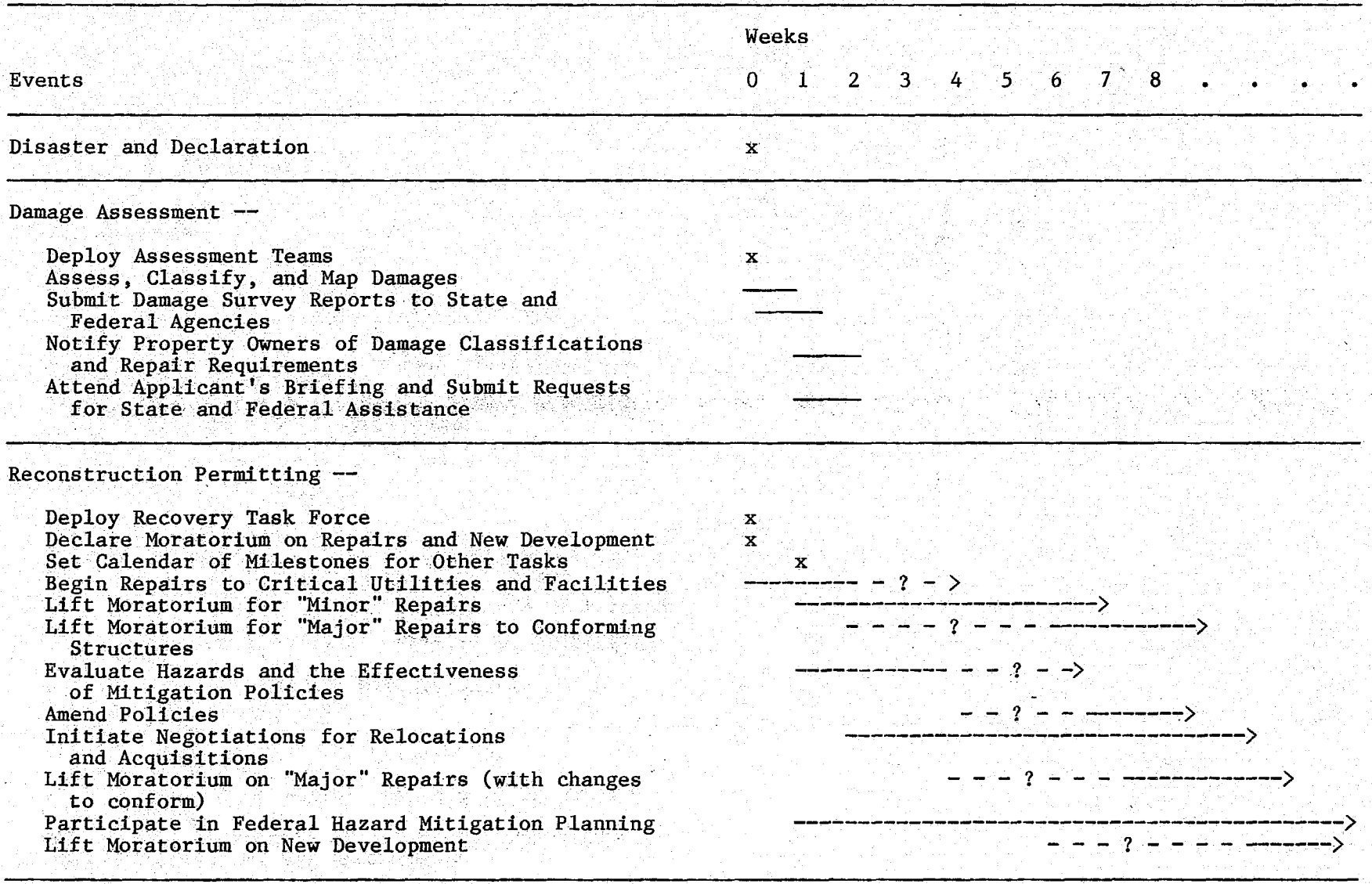
Documents to Prepare in Advance of a Major Storm

Local governments should prepare several documents in advance of a disaster in order to make repairs and reconstruction move as smoothly, quickly, and efficiently as possible. These documents include:

1. a hazard mitigation plan;

2. a reconstruction plan;

Figure 7.15: Sequence of Local Activities in Assessing Damages and Permitting Reconstruction



3. ordinances and resolutions dealing with hazard mitigation and reconstruction;

4. detailed and accurate property information.

The hazard mitigation plan will identify hazard areas in the community, the community's vulnerability to damages, and policies and principles guiding new development, repairs, and reconstruction to be reasonably safe from storm damages. The plan could include policies calling for and/or governing the relocation of buildings, roads, and utilities. The plan should be backed up by formally adopted development management measures (zoning regulations, public works policies, land acquisition programs, etc.). The hazard mitigation plan, and the policies adopted pursuant to it, provide the foundation for how reconstruction takes place -- the standards for reconstruction to follow.

The reconstruction plan will identify personnel responsibilities and procedures for assessing damages and permitting repairs and reconstruction. It should designate, in advance of disaster, damage assessment teams, a recovery task force (if one is desired), and the roles different local citizens and employees will play during community recovery. It should outline procedures for assessing and mapping damages, for notifying property owners, for reviewing the effectiveness of local hazard mitigation policies, and for issuing permits to repair and rebuild damaged structures. At a minimum, the reconstruction plan should contain three sections:

1. the procedures to follow (and their sequence and timing) in assessing damages and permitting repairs and reconstruction;

2. the standards for development that repairs and reconstruction must follow to reduce the risk of future damages (referring to the hazard mitigation plan); and

3. the identification of particularly hazardous areas which are likely to need special treatment (such as the relocation of buildings, roads, and utility lines) after a hurricane strikes, as well as the types of action that could be taken.

The reconstruction plan cannot cover all contingencies and make all decisions beforehand since nobody can accurately predict the exact type, amount, and location of damages the community will suffer. Therefore, the plan needs to embody a policy framework and a procedural framework for the specific decisions that can only be made during reconstruction, such as those dealing with the relocation of roads and utilities. To facilitate these decisions, the reconstruction plan should spell out (1) who is to make these decisions (such as the local legislative body, the planning board, or a special "recovery task force") and (2) what criteria they shall use to make the decisions (such as hazard area maps and the community's hazard mitigation policies). Even though the decisions themselves cannot be made until after disaster strikes, the reconstruction plan can lay the foundation of policies, priorities, and procedures on which these decisions are based.

Ordinances and resolutions dealing with hazard mitigation and reconstruction should, to the maximum extent possible, be adopted and in force before disaster strikes the community. This allows the community to formulate and enact policies and programs in a more rational manner, rather than responding to problems and trying to resolve them at the "heat of the moment" immediately after disaster strikes. Advance planning firmly establishes the policies, guidelines, and standards for reconstruction to follow. It reduces delays in community recovery because larger issues have already been resolved beforehand regarding what should be required of development and what procedures local government should follow in managing repairs and reconstruction. By formulating ordinances, regulations, and other measures before the storm, the local government also has adequate time for public review and comment and for following proper administrative procedures governing new laws and programs. Ordinances and resolutions can be designed to invoke certain standards and procedures (for damage assessment, repairs, and reconstruction) when the local government has declared a "state of emergency"; these could remain in effect for whatever period of time the local government deems appropriate. The local government could have a temporary development moratorium already designed and on the books before the storm and have it go into effect when a "state of emergency" is declared. Again, having policies, standards, and procedures ready and in place when disaster strikes will reduce confusion and delays in the disaster's aftermath.

Maintaining detailed property information as part of the local government's normal operations will greatly assist in damage assessments and reconstruction permitting decisions. Having this information on hand when disaster strikes will, again, reduce delays and confusion. The local government should have a complete and easily interpretable set of property maps and a corresponding list of property owners and their addresses. This will help in identifying damaged properties and in notifying property owners of any needed repairs. The maps and list of owners should be accompanied by photographs of individual properties or oblique aerial photographs of all sections of the community. This will help in identifying damaged structures, especially if they are barely recognizable or washed onto another site. It will also help in determining the structure's initial market value, which is usually the base value used in assessing damages and in determining whether a nonconforming structure must comply with existing development regulations when it is rebuilt or repaired.

REFERENCES: CHAPTER 7

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CHAPTER 8:

CONCLUSIONS

This report has provided local governments in coastal North Carolina with information to use in managing development and post-disaster reconstruction to reduce the risk of future storm damages. It has discussed important issues surrounding hazard mitigation and reconstruction planning. It has presented various state and federal programs that help protect development against hurricane damages and that help the community recover from disaster. It has presented numerous measures that local governments can adopt to manage new development and reconstruction. It has presented procedures for a local government to follow in assessing its vulnerability to storm damages, in selecting appropriate development policies to reduce this vulnerability, and in planning for post-disaster reconstruction.

This information is intended to help a local government wed two of its most important roles -- managing emergencies and managing development. All too often, a local government approaches these roles in isolation from one another without seeing how measures to manage development can help reduce the burdens a community will face in the wake of disaster. The documents mentioned at the end of the last chapter (a hazard mitigation plan, a reconstruction plan, appropriate ordinances and resolutions, and detailed property records) should prove to be valuable aids in helping the community manage development and facilitate reconstruction.

Hazard mitigation and reconstruction plans should not be prepared separately; they should operate together as part of a more comprehensive local planning effort. Comprehensive planning gives the community a forum for addressing and balancing a full range of local development objectives, not just those related to storm hazards. It allows the community to chart specific courses of action consistent with different development objectives. Local land use plans prepared in compliance with the Coastal Area Management Act, as basic comprehensive planning documents, provide a logical place for communities to identify and address hazard mitigation and reconstruction problems. By incorporating a more detailed analysis of the community's storm hazards and reconstruction permitting procedures into the local land use plan, the local government will be able to balance hazard mitigation against other development needs and objectives. The local government will be well-prepared to select an appropriate course of action that will make the community safer from hurricanes and other major storms.

Ordinances and resolutions concerning new development and post-disaster reconstruction will put the community's hazard mitigation policies into effect. They translate abstract plans and policies into concrete action. Maintaining detailed property information will not only help the community assess damages and make reconstruction permitting decisions; it should also prove valuable to the local government's other development management activities.

While hazard mitigation and reconstruction planning should be incorporated into the community's comprehensive land use planning efforts, they should also be coordinated with the community's emergency planning efforts.

Local evacuation plans, emergency operations plans, and disaster relief and assistance plans deal mainly with short-term concerns surrounding a disaster, but they also affect and are affected by the community's development decisions. Development conditions in the community will dictate what emergency actions a local government must take in the face of a major storm. Emergency plans set up the special roles local officials must play and the special procedures local government must follow during and immediately after a disaster; these can easily influence the character of post-disaster reconstruction.

In order to facilitate local hazard mitigation and reconstruction planning, state agencies must also take a more active role and examine their policies more closely. State agencies should serve as a source of support for local efforts, providing technical assistance, arranging financial assistance, and training local officials in such things as damage assessment. State agencies should cooperate with each other more to establish a more consistent framework of state policies and programs within which local governments can operate. For example, the Coastal Resources Commission and the Building Code Council could work together to establish more consistent standards for construction in the coastal region. State agencies should be flexible in allowing a community to pursue different measures that protect against storm damages, such as construction standards more stringent than the State Building Code. State agencies should also provide a model for coordinating development planning and emergency planning. For example, the Office of Coastal Management and the Division of Emergency Management could work together more on hurricane-related problems, such as evacuation, disaster assistance, and reconstruction procedures. Such state actions would make local actions more effective at reducing the risk of storm damages.

This report represents an important beginning for North Carolina's coastal communities. It identifies the tools that local governments can use to manage development and post-disaster reconstruction to minimize the damages resulting from future hurricanes, northeasters, and other major storms. As the primary guardian of the public health, safety, and general welfare, local government faces an important responsibility to reduce the risk of property damages and loss of life attending coastal development. It must start planning now for the storms yet to come.

APPENDIX A:

NORTH CAROLINA STORMS OF THE 20TH CENTURY

The following list is taken from Storms, People and Property in Coastal North Carolina by Simon Baker (UNC Sea Grant Publication Number UNC-SG-78-15), pp. 70 - 77.

COASTAL HURRICANES OF THE 20TH CENTURY

The following list represents those tropical storms which were of full hurricane strength at the time they reached coastal North Carolina. The decayed stages of hurricanes reaching this area are not listed. Storms passing close enough off shore to affect land areas are included even though they did not make landfall.

1901 July 11: Made landfall near Oregon Inlet. No record of damage.

1903 September 15: Passed off shore but affected the northern Outer Banks.

1904 September 14: Made landfall between Charleston, South Carolina, and the North Carolina state line. Damage to crops in eastern and central North Carolina from wind and rain.

1904 November 13: Passed off shore near Cape Hatteras. Three wrecked schooners. Several persons drowned on land and at sea.

1906 September 17: Made landfall near Myrtle Beach, South Carolina. Property damage at Wrightsville Beach.

1908 July 30: Passed up the coast close to Cape Hatteras. Heavy rainfall caused flooding in the eastern counties. Considerable property damage at Wrightsville Beach.

1913 September 3: Made landfall between Hatteras and Beaufort. Storm surge in Pamlico Sound washed away railroad bridges at Washington and New Bern. Wind and rain caused severe damage to crops as far west as Durham.

1920 September 22: Made landfall between Wilmington and Morehead City. One person killed and many injured in Pitt County.

1924 August 25: Passed off shore just east of Hatteras. Two people drowned and Ocracoke partially flooded.

1930 September 12: Passed off shore causing minor wind damage from Atlantic Beach to Hatteras.

1933 August 22-23: Made landfall at Cape Hatteras. High tides and winds caused great damage in northeastern counties estimated at $250,000.

1933 September 15-16: Made landfall west of Hatteras. Storm surge in Pamlico and Albemarle Sounds caused 21 deaths and $3 million in damage. New Bern flooded.

1936 September 18: Passed up the coast slightly east of Hatteras. Estimated damage of $55,000 to the northern coast. Heavy damage to crops.

1938 September 21: Passed off shore on its way north where it did considerable damage and was called "The Great New England Hurricane of 1938." No damage or loss of life reported in North Carolina.

1944 August 1: Made landfall near Southport. Heavy damage to structures at Carolina Beach. Considerable crop damage in the southern coastal counties. Estimated total damage was $2 million.

1944 September 14: Passed a short distance east of Cape Hatteras moving northward. On the central and northern coastal areas 108 buildings were destroyed and more than 600 damaged. Estimated damage to crops at $1 million. Heavy damage in Elizabeth City and Nags Head. One person killed.

1949 August 24: Passed off shore at Cape Hatteras directly over the Diamond Shoals Lightship. An estimated $50,000 in property damage occurred, mostly in the vicinity of Buxton. Two persons died.

1953 August 13: Hurricane Barbara made landfall between Morehead City and Ocracoke. Estimated property damage was $100,000 while the crop loss was $1 million. One person died.

1954 August 30: Hurricane Carol passed just to the east of Cape Hatteras. Widespread light damage came to an estimated $250,000.

1954 September 10: Hurricane Edna passed about 60 miles east of Cape Hatteras. Minor but widespread damage was estimated at $75,000 for property and $40,000 for crops.

1954 October 15: Hurricane Hazel made landfall right on the South Carolina line. From that point northward to Cape Lookout, the ocean front was ravaged by storm surge. At Long Beach 352 of the existing 357 buildings were totally destroyed. Nearby beaches suffered similar damage. Miles of grass covered dunes disappeared. Flooding occurred in Washington, New Bern and Elizabeth City. Heavy wind damage experienced all over eastern North Carolina and record amounts of rainfall were recorded. Nineteen people, most of whom were in beach locations died. Total property damage amounted to approximately $125 million.

1955 August 12: Hurricane Connie made landfall close to Cape Lookout. Caused severe flooding in low-lying coastal areas and around the sounds. Heavy beach erosion also occurred. No deaths were reported. Hurricane Diane followed in five days and made it impossible to assess the damage caused by this storm.

1955 August 17: Hurricane Diane made landfall near Carolina Beach and passed over Wilmington. Winds caused crop damage as far west as Raleigh. Heavy flooding occurred in Belhaven, Washington and New Bern. Crop damage in the eastern counties caused by this storm and Connie came to more than $28 million much of it due to salt water flooding and rivers overflowing their banks. No deaths were reported.

1955 September 19: Hurricane Ione made landfall near Salter Path on Bogue Banks. In spite of high winds, damage from this source was minor. Heavy rains falling on already waterlogged soils were responsible for the most damage. Storm surge was responsible for the flooding of thousands of acres, and in New Bern 40 city blocks were inundated. Hundreds of homes were washed away. Seven people died. Estimated damage to crops and property was about $88 million.

1958 September 27: Hurricane Helene passed off the coast from Wilmington to Cape Hatteras. Very high winds were responsible for damage to crops and structures estimated at $11 million.

1960 September 11: Hurricane Donna made landfall between Wilmington and Morehead City and moved up the coast. Heavy damage was experienced by coastal communities from Wilmington to Nags Head. Beach erosion was considerable, and the corn crop in the coastal counties suffered severe wind damage. Eight people died, and damage was estimated at several millions of dollars.

1964 September 1: Hurricane Cleo passed from western North Carolina out to sea in the vicinity of Elizabeth City. Heavy rains caused flooding and damage to crops in the northeast.

1964 October 16: Hurricane Isbell made landfall near Morehead City and moved northward over the eastern counties. Caused some flash flooding and damage to the peanut crop.

1968 October 20: Hurricane Gladys moved up the coast and out to sea in the vicinity of Cape Hatteras. Damage was light and the state benefited from two days of moderate rainfall.

1971 September 30: Hurricane Ginger made landfall near Morehead City and began to dissipate as it moved inland. Tides were six feet or more above normal at Washington, Aurora, New Bern and Cherry Point. Thousands of acres of corn and soybeans in the eastern counties were affected. Damage was estimated at $10 million.

1976 August 9: Hurricane Belle passed east of Cape Hatteras on its way north. Beaches were evacuated but only scattered minor damage occurred.

SOME SEVERE 20TH CENTURY EXTRATROPICAL STORMS

The following list of noteworthy storms has been compiled because tropical storms are not the only significant weather disturbances experienced on the North Carolina coast. These non-tropical storms generally occur during the winter and spring months of the year. Since they are numerous and vary in strength and destructiveness, only major storms are included in this list. The compilation is based on a study of published records of the National Weather Service and its predecessor organizations from 1900 to the present. Information was obtained from various issues of the Monthly Bulletin, the Monthly Weather Review, Climatological Data of the U.S. by Sections, Climatological Data and Storm Data.

1902 December 4-5: An inland storm caused dangerous gales on the coast. Considerable waterfront damage occurred at Southport, Wilmington, Beaufort and Morehead City. Communications were interrupted because of damage to telephone and telegraph lines. Some wharves were blown or washed away, and several small vessels were wrecked.

1903 February 16: An inland storm caused gale winds throughout the state. Wilmington, New Bern and Washington experienced damage. Land between Pamlico Sound and the Atlantic Ocean was flooded. Seventeen persons died in the sinking of the passenger steamer "Olive" in the Chowan River.

1903 October 8-10: A severe storm formed off the North Carolina coast. Winds of 63 miles per hour were recorded at Hatteras.

1910 February 24-25: A northeast storm off the coast generated winds of 60 miles per hour at Hatteras.

1917 September 14-15: Heavy damage to property and crops was caused by a storm moving inland over the southern coast of North Carolina and then out to sea north of Hatteras. Roads and small bridges were washed out by a rainfall of four to eight inches.

1924 March 11: A storm moving northward along and near the coast generated winds of 66 miles per hour at Hatteras. These off shore winds caused unusually low water levels at New Bern and other places on western Pamlico Sound.

1932 March 6: An inland storm brought gale winds to the Atlantic and sound shores. Fishing nets, small boats, wharves, bridges, roads, buildings and telephone poles were damaged or destroyed. Dare County received more than half of the damage, and on the Outer Banks three new inlets were formed.

1932 November 28: More than $50,000 in damage was caused on the south coast because of strong winds and high tide.

1933 January 25-29: Gale winds were reported at Hatteras. Coastal damage to roads and small craft reported.

1947 November 2-3: A northeast storm caused coastal damage as a result of the combination of strong winds and high tides. Morehead City and other coastal cities experienced flooding and several boats were grounded and destroyed.

1948 February 1: A northeast storm brought heavy snow to the eastern part of the state. Some coastal cities were practically isolated, and Wilmington reported more than $1 million in damage. High tides and northeast winds caused damage along the coast.

1954 May 13: An inland storm which moved off the coast of North Carolina generated winds causing over $100,000 damage to beaches. A 14,000-ton freighter was destroyed as a result of this storm near Cape Hatteras.

1956 January 8-12: Wind-driven water caused by a coastal storm resulted in $50,000 property damage on the northern Outer Banks. Five cottages were destroyed in the area of Kitty Hawk. On Hatteras Island, a three-mile stretch of highway pavement was washed out.

1956 October 16-18, 27-30: These two northeast storms caused damage to beach highways, small craft and piers as a result of high tides. In the second storm three people were lost from fishing vessels.

1957 October 5-6: Winds reached 50 miles per hour along the northern coast during this off shore storm. High tides caused by prolonged easterly winds drove water over the Outer Banks highway and caused considerable beach erosion.

1958 October 19-23: A low pressure storm about 200 miles east of Cape Hatteras created wind gusts to 70 miles per hour from Cape Fear to the Virginia line. High tides affected beaches and cut the road from Oregon Inlet to Hatteras in several places. High water pushed into the Neuse River causing some flooding in New Bern.

1962 March 5-8: This gigantic "Northeaster" known as the Ash Wednesday Storm caused erosion on the coast from Hatteras northward greater than in any previously known storm. It opened an inlet 200 feet wide on Hatteras Island and destroyed miles of protective dunes. Miles of paved highways were either washed out or buried in sand. Beach homes by the hundreds were destroyed or damaged and hundreds of automobiles were either buried in sand or submerged in water. Waves more than 20 feet high on top of 10 foot tides were responsible for most of the damage. At Nags Head wind gusts near 70 miles per hour were recorded. Two people were known to have died as a result of the storm. Preliminary property damage estimates came to $12 million.

1962 June 29: An off shore low pressure storm caused torrential rains in the central coastal counties. Amounts varied from four to 17 inches in 24 hours. Agricultural losses were high, particularly in the tobacco crop. High tides and winds were responsible for some beach erosion.

1962 November 25-December 5: A persistent low pressure storm off the coast caused very heavy beach erosion. Beaches were cut back as much as 50 feet in some places and sand dunes were damaged. Several buildings were destroyed and many damaged.

1964 February 12: An off-shore low pressure storm generated rough seas which eroded the beach at Kill Devil Hills.

1964 May 3: The southeast coast was affected by a low pressure storm off shore. Gusts to 100 miles per hour were reported. Some wind damage occurred but beach erosion was slight.

1967 December 28: A coastal low pressure storm caused moderate damage from Wilmington to Morehead City. Wind gusts to 76 miles per hour were reported in Wilmington.

1968 May 26-27: A coastal low pressure storm caused heavy rain and strong winds in the northern coastal area. Widespread damage to boats and waterfront structures such as docks and piers was reported.

1969 November 1-2: A low pressure coastal storm moving northeastward was responsible for 60 mile per hour wind gusts. Moderate beach erosion occurred.

1970 December 31: On the southern coast some beach erosion and damage to piers was caused by a low pressure storm moving northward. Gales and high seas were reported.

1972 May 22-27: The northern coast was affected by a low pressure storm. Heavy beach erosion occurred and winds up to 50 miles per hour were recorded on shore.

1973 February 9-10: High winds and seas along the coast were caused by a low pressure storm off shore. Heavy beach erosion and property damage in various places resulted.

1973 March 22: A northeast storm blew up 10-12 foot seas. Highways were damaged along with some beach front property.

1976 February 1-2: A severe wind storm affected the northern coast particularly from Ocracoke through Manteo. Wind driven tides at the time covered two thirds of Hatteras Island. Portions of Manteo were flooded. Gusts of 70-90 miles per hour were reported at various Outer Banks locations.

APPENDIX B:

ANNOTATED BIBLIOGRAPHY

This bibliography contains a comprehensive collection of literature dealing with natural hazards and community planning. The bibliography breaks the literature into several categories:

Natural Hazards in General (p. B-2)
Hurricanes in General (p. B-4)
Coastal Development and Coastal Hazards (p. B-6)
Hurricane Hazard Mitigation (p. B-8)
- General
- Land Use Management
- Building Design and Construction
- Evacuation

Disaster Assistance (p. B-19)

Natural Hazards in General

Bolt, B.A., W.L. Horn, G.A. MacDonald, and R.F. Scott. 1977. Geological Hazards (Revised, 2nd Edition). New York, NY: Springer-Verlag.

A clear and comprehensive presentation of seven types of natural hazards: earthquakes, volcanoes, tsunamis, landslides, ground subsidence, avalanches, and floods. Presents the geology of these hazards and the nature of human response to them. Concludes with a chapter on hazard mitigation and control (risk zoning, etc.) that lacks detail but raises good points about risk assessment. Offers no specific guidelines for planning other than the recognition and identification of hazards.

Foster, Harold D. 1980. Disaster Planning: The Preservation of Life and Property. New York: Springer-Verlag (Series on Environmental Management).

Presents the full range of elements that comprise disaster planning. Includes excellent discussions of the range of issues facing communities during reconstruction and of methods for identifying and mapping high-risk areas. Also presents suggestions for the design of disaster warning systems and a variety of methods for predicting disasters and the community's response to them.

Francaviglia, Richard F. "Xenia Rebuilds: Effects of Pre-disaster Conditioning on Post-disaster Development" in Journal of the American Institute of Planners 44:1 (January 1978). Chicago, IL: American Institute of Planners.

Excellent, concise article on the forces that kept Xenia from changing its land use patterns after much of the city was destroyed by a tornado. Emphasizes the need for governmental planning to keep pace with private redevelopment pressures in order for a coordinated recovery or improvement to occur. Points out the role played during reconstruction by the citizenry's images of what Xenia was and should be.

Haas, J.E., R.W. Kates, and M.J. Bowden, eds. 1977. Reconstruction Following Disaster. Cambridge, MA: MIT Press (Environmental Studies Series).

Broad and insightful presentation of the issues facing communities that have been stricken by natural disasters. Draws heavily on case studies in four cities that have gone through disaster reconstruction (San Francisco, Anchorage, Rapid City, and Managua). Of particular interest are the introductory and concluding chapters, which make inferences from the four case studies to chart the sequence of events common after disaster strikes a community, including some useful "dos and don'ts" that apply during the recovery process.

National Governors' Association. 1978. 1978 Emergency Preparedness Project: Final Report. Washington, DC: U.S. Government Printing Office (Stock #008-040-00080-0).

Reports the findings of the NGA's broad-ranging assessment of state emergency management programs. Highlights the lack of coordination between state preparedness and response functions (usually handled by a central state emergency office) and state mitigation and recovery functions

(usually handled by many individual agencies). Uncovers a variety of other problems facing state emergency management agencies, such as the lack of inter-governmental communication and the need to clarify and/or modify federal financial aid procedures. Includes a number of recommendations for state emergency management officials. More of interest to state program managers than to local administrators.

National Governors' Association. 1979. Comprehensive Emergency Management: A Governor's Guide. Washington, DC: U.S. Government Printing Office (Stock #008-040-00079-6).

Points out the need for more coordinated emergency management at the state level (covering mitigation, preparedness, response, and recovery). Outlines the role of federal, state, and local agencies with regard to different types of emergencies. Presents brief suggestions (geared toward a governor's responsibilities) for the establishment of a state comprehensive emergency management program and for obtaining federal assistance during an emergency. More useful to state program managers than to local officials.

Rubin, Claire B. 1979. Natural Disaster Recovery Planning for Local Public Officials. Washington, DC: Federal Emergency Management Agency (Report No. MP-85).

Briefly describes local disaster recovery experiences and research observations "with the hope of sparing other communities the expense and anguish of learning first-hand." Presents issues that commonly arise during disaster recovery and influence the integration of reconstruction into comprehensive community planning. Includes useful sections on "Decision-making Under Extreme Pressure" and "Warning Signs of Insufficient Preparation."

Very general approach, designed to orient local elected officials and administrators to some basic disaster planning concepts and issues.

Rubin, Claire B., et al. 1981 (September). Long-term Recovery from Natural Disasters: A Comparative Analysis of Six Local Experiences. Washington, DC: Academy for Contemporary Problems.

Presents six case studies of community response to flooding, three of which deal with coastal flooding. Draws comparisons on (1) the size of the disaster, (2) the nature of response and the beginnings of long-term recovery, (3) previous disaster experience, (4) external resources, (5) local public capacity and leadership, (6) intergovernmental relations, and (7) mitigation efforts. The descriptions deal mainly with local government operations during the response phase immediately following the disaster. While the authors do an adequate job at presenting the issues which exist in each community, they provide no insight or recommendations regarding the design of recovery and mitigation measures or local policy adoption.

Each community's identity is disguised, making it difficult for the reader to follow up on or more deeply explore the recovery and mitigation efforts by contacting the case study communities directly. The report includes no listing of relevant local plans.

Hurricanes in General

Baker, Simon. 1978 (August). Storms, People, and Property in Coastal North Carolina. Raleigh, NC: UNC Sea Grant College Program (Publication No. UNC-SG-78-15).

Short and simple booklet designed for the average coastal resident. Briefly describes the history of hurricanes and northeasters in North Carolina and the damaging forces associated with them (storm surge, freshwater flooding, and high winds). Presents basic rules of thumb for evacuation and safety before and immediately after a flooding disaster and a few tips on hurricane-resistant home construction. Appendices include a list of local civil preparedness agencies in N.C.'s coastal counties (some addresses and phone numbers may be out-of-date) and a list of "Disaster Fact Sheets" available from the North Carolina Agricultural Extension Service.

Provides good information for local residents, but offers few insights for local administrators.

Brinkmann, Waltraud. 1975. Hurricane Hazard in the United States: A Research Assessment. Boulder, CO: University of Colorado - Institute of Behavioral Science.

Briefly outlines the status (as of 1975) of hurricane research. Breaks research into five areas:

1. modifying the hazard (e.g. seeding hurricanes to reduce their strength);
2. strengthening the physical environment (e.g. man-made shore protection works);
3. altering coastal development practices (e.g. land use management, building codes, and forecasting/warning systems);
4. designing insurance programs (e.g. the structure and impacts of the National Flood Insurance Program);
5. disaster relief and rehabilitation (e.g. federal aid programs and community recovery processes).

Calls for greater attention to development management tools as the key means of hurricane protection.

Dunn, G. E. and B. I, Miller. 1960. Atlantic Hurricanes. Baton Rouge, LA: Louisiana State University Press.

A detailed historical analysis of all Atlantic hurricanes through 1958 from about 1700. Presents an account of the path of Hurricane Hazel through North Carolina in 1954. Also presents maximum rainfal, flood and surge levels for different coastal areas through 1958.

Herbert, Paul J. and Glenn Taylor. 1975. Hurricane Experience Levels of Coastal County Populations - Texas to Maine. Coral Gables, FL: National Hurricane Center.

Examines population statistics for the entire Atlantic coastline and compares the history of hurricane strikes in individual coastal counties with the history of development in those counties, covering up to 1970. The combined statistics show that over 75% of all Atlantic and Gulf coast residents have never experienced a direct hit by a major hurricane.

Herbert, Paul J. and Glenn Taylor. 1978. The Deadliest, Costliest, and Most U.S. Hurricanes of the Century. Coral Gables, FL: National Hurricane Center.

Presents graphs, charts, tables and figures of major hurricanes in the U.S. since 1900, covering their strength, cost of damages, and spatial distribution. Concludes that a future disaster is inevitable due to the increased development and low hurricane experience of coastal area residents.

Simpson, R. H. and H. Riehl. 1981. The Hurricane and Its Impact. Baton Rouge, LA: Louisiana State University Press.

An exhaustive and authoritative book on the nature of hurricanes, their formation, structure and impacts. Everything one needs to know about the physical storm itself; what is missing is an account of how to deal with it.

U.S. Army Corps of Engineers--Mobile District. 1981. Hurricane Frederic - Post Disaster Report. Mobile, AL: U.S. Army Corps of Engineers.

Description of the meterological history of the hurricane and its impacts on six coastal communities. Outlines damages in terms of causes (winds, waves, floods), and effects (residential, commercial, public, utilities). Examines emergency preparedness and response activities and detailed costs of these activities. Does not discuss rebuilding or mitigation actions.

Coastal Development and Coastal Hazards

Brower, David, Francis Parker, and Dirk Frankenberg. 1976. Ecological Determinants of Coastal Area Management. Raleigh, NC: UNC Sea Grant College Program (Publication No. UNC-SG-76-05).

Divides the coastal area into barrier island systems and lagoon-estuary systems. Discusses dominant processes of each and their interactions. The dynamic nature of coastal areas is stressed. Man's activities serve to increase the vulnerability of an island to changes by lessen-its ability to react naturally to daily and storm activities.

The Conservation Foundation. 1980. Coastal Environmental Management: Guidelines for Conservation of Resources and Protection against Storm Hazards. Washington, DC: Council on Environmental Quality.

Offers 36 policy recommendations for local coastal government, geared towards developing coasts. Gives a good description of the characteristics, ecological features, and hazards of coastal uplands, coastal floodplains, saltwater wetland banks and bluffs, dunelands, beaches, coastal waters and basins. Discusses each separately with specific policies, means of implementation, and relevant federal policies.

Dolan, Robert and Bruce Hayden. "Templates of Change: Storms and Shoreline Hazards" in Oceanus 23:4 (Winter 80/81). Woods Hole, MA: Woods Hole Oceanographic Institute.

Briefly presents results of research into storm damage patterns on Mid-Atlantic barrier islands. Identifies long-term rates of shoreline change (erosion and accretion) for 100-meter segments of the Mid-Atlantic coast (North Carolina to New Jersey). Finds that storm surge damage on the barrier islands increases in proportion to the magnitude of shoreline erosion for a particular stretch of beach. Concludes that "sections of sedimentary coasts, which have experienced storm damage and serious erosion in the past, are likely to experience more of the same in the future."

French, Steven. "The Urbanization of Hazardous Areas: Flood Plains and Barrier Islands in North Carolina," in 1979 Proceedings: The First Annual Urban Affairs Conference of the University of North Carolina. Chapel Hill, NC: UNC Urban Studies Council.

Briefly describes the nature and extent of flood-hazard areas in North Carolina. Identifies increasing development in these areas as the key factor behind the rising trend in annual flood losses. Data in the article indicate that while recent flood losses have been concentrated in the mountains, development in flood hazard areas and potential future losses are greatest in the state's coastal region.

Leatherman, Steven P. 1979. Barrier Island Handbook. Amherst, MA: National Park Service.

A short book of barrier island ecology. Heavily illustrated throughout, the book presents basic scientific information in a manner that can be understood by anyone. Comprehensively covers barrier island origins, ecological processes and functions, and the natural and man-made forces acting to change barrier islands.

Very useful as an introduction to the ecology of barrier islands. Has a good bibliography where more information can be found.

U.S. Conference of Mayors, National Community Development Association, and Urban Land Institute. 1979 (February). The Private Development Process: A Guidebook for Local Government. Washington, DC: U.S. Department of Housing and Urban Development - Office of Policy Development and Research (Report No. HUD-PDR-352-2).

The guidebook is designed to help local officials understand how private housing developers make investment decisions. It briefly explains such things as market analysis, site selection, financing, the rehabilitation of existing structures, and the private developer's role in subsidized housing. It is a brief and easy-to-understand introduction to the mechanics of residential development decision-making.

White, Gilbert F., Earl J. Baker, et al. 1976. Natural Hazard Management in Coastal Areas. Washington, DC: National Oceanic and Atmospheric Administration-Office of Coastal Zone Management.

Presents all major coastal hazards (hurricanes, floods, erosion, landslide, earthquakes, etc.), discussing the nature of the hazard, its destructive components, the population at risk, and the probability of occurrence. Discusses possible adjustments to each hazard, but does not compare their effectiveness.

Gives list of responsible agencies and administrative policies in each state.

Hurricane Hazard Mitigation

General --

Baker, Earl J., ed. 1980. Hurricanes and Coastal Storms. Gainesville, FL: University of Florida Sea Grant College Program (Report No. 33).

Proceedings of a 1979 national conference presenting 35 papers covering warning and evacuation, local disaster response planning, National Flood Insurance Program, land use and growth management, coastal construction, post-disaster hazard mitigation, hurricane protection and awareness, public participation in policy formation, and computer models of disaster effects. Authors are from government, academia, and private sectors. Because of the length of each paper (4-6 pages), detail is lacking, but this is a useful overview of state-of-the-art knowledge in hurricane planning, circa 1980.

Brower, David, Candace Carraway, and Thomas Pollard. 1981 (December). Developing a Growth Management System for Rural Coastal Communities. Raleigh, NC: UNC Sea Grant College Program (Publication No. UNC-SG-WP-9).

This report describes a process for devising programs in North Carolina's rural coastal communities for managing the location, quantity, rate, and quality of development. It does not provide a ready-made system, since local development objectives vary from place to place, but briefly describes a set of six basic steps for communities to follow in their land use planning. An extensive appendix describes the various techniques that can be used in North Carolina to manage growth: land acquisition, public spending, taxation, and development regulation.

Campbell, William A. and Milton S. Heath, Jr. 1979 (February). Legal Aspects of Flood Plain Management. Raleigh, NC: U.N.C. Water Resources Research Institute (Report No. UNC-WRRI-79-137).

Critically analyzes existing North Carolina legislation which determines what the state and local governments can do to manage development in flood-prone areas. Outlines the major elements of an effective flood-plain management program at the state and local levels. Contains good descriptions of the National Flood Insurance Program and its interaction with North Carolina's Coastal Area Management Act and other coastal legislation. Includes a clear and concise presentation on "Flood Plain Management and the Taking Issue." Well-written, brief, and easy to understand, though a little dated in its discussion of CAMA regulations.

Coastal Area Planning and Development Commission. 1980. A Coordination, Education and Mitigation Model for Disaster Preparedness in Coastal Areas. Brunswick, GA: Coastal Area Planning and Development Commission.

This report outlines the role that substate regional planning agencies can play in disaster planning, recognizing that local plans are often uncoordinated and that local governments often lack the resources for adequate disaster planning. The report identifies the responsibilities of state and local governments in disaster preparedness and presents the results of

a nationwide survey identifying the roles that substate regional planning agencies play in disaster preparedness and response. It then defines a disaster preparedness program for the Coastal Area Planning and Development Commission that includes communications/warning systems, evacuation, public awareness, hazard mitigation, and the coordination of local, regional, and state efforts.

Federal Emergency Management Agency - Federal Insurance Administration and U.S. Department of Housing and Urban Development - Office of Policy Development and Research. 1981 (March). Evaluation of the Economic, Social, and Environmental Effects of Floodplain Regulations. Washington, DC: FEMA (Report No. FIA-8).

This study analyzed the impacts of floodplain regulations on 23 communities (covering different locations, sizes, flood hazard types, and economic conditions). Regulations were evaluated by projecting development for 1980 and 1990 under three scenarios: (1) no regulations, (2) moderate regulations similar to current FIA requirements, and (3) stringent regulations forbidding new development and substantial improvements to existing structures. The study found that moderate regulations will greatly reduce the rate of increase in flood losses, but will not cause them to decline.

Ralph M. Field Associates, Inc. and Abeles, Schwartz, Haeckel, and Silverblatt, Inc. 1981 (March). Evaluation of Alternative Means of Implementing Section 1362 of the National Flood Insurance Act of 1968. Washington, DC: Federal Emergency Management Agency (Report No. M&R-4).

This study examines the Section 1362 acquisition/relocation program by (1) identifying alternative means for carrying it out, (2) estimating the number of structures eligible for purchase under it, (3) identifying its effects on individuals and communities, (4) identifying its relationship to other federal policies, and (5) estimating the federal costs involved. The report defines the role of the Section 1362 program and the benefits it provides.

Kusler, Jon. 1982. Innovation in Local Floodplain Management: A Summary of Community Experience. Boulder, CO: University of Colorado - Institute of Behavioral Science (Special Publication No. 4).

This report presents local programs that are "innovative" in that they exceed the standards of the National Flood Insurance Program and applicable state regulations. These programs include ones with strong enforcement provisions, regulations establishing elevation requirements and other requirements exceeding state and federal standards, and combining regulations with land acquisition and other non-regulatory measures. The report briefly touches on some of the problems encountered in administering these programs. Unlike most floodplain management reports, it talks about inland communities and coastal communities separately in presenting the approaches they have used to deal with floodplain development. The report includes a brief chapter on how these programs have fared in court. Its appendix contains brief profiles of how over 70 communities throughout the country (18 of them coastal) have used "innovative" floodplain management measures.

Kusler, Jon and Thomas Lee. 1972 (February). Regulations for Flood Plains. Chicago, IL: American Society of Planning Officials (Planning Advisory Service Report No. 277).

This report is a good introduction to the terms and concepts involved in floodplain land use management. It describes common legal questions surrounding floodplain regulations and suggests steps to include in developing a local floodplain management program. It includes a useful section on tailoring zoning ordinances to flood hazard data. The report deals primarily with riverine communities and fails to account for some of the special problems coastal communities encounter.

Platt, Rutherford H. and George M. McMullen. 1980 (May). Post-flood Recovery and Hazard Mitigation: Lessons from the Massachusetts Coast, February 1978. Amherst, MA: University of Massachusetts--Water Resources Research Center (Publication No. 115).

Calls for fuller integration of hazard mitigation into post-disaster recovery activities at all levels of government. Reviews the progress made after the Great Blizzard and Coastal Storm of 1978 by federal, state, and local governments in developing and executing mitigation strategies (e.g., acquisition, relocation, land use regulations, and construction standards).

Describes recovery activities in Scituate (a coastal community where 95 homes were destroyed and over 1,000 homes were damaged) as a "key example of the need and opportunity to practice hazard mitigation." Highlights conflicts between mitigation and rapid reconstruction and the shortcomings of existing federal, state, and local policies.

May be a little dated in its description of federal disaster programs, but a good, brief case study of the issues involved in hazard mitigation.

Office of Emergency and Energy Services. 1980 (July). Hurricane Hazard Mitigation in Coastal Virginia. Richmond, VA: Office of Emergency and Energy Services.

Offers local officials a brief discussion of the hurricane threat, improved construction standards, and land use management tools available to local governments in Virginia. Includes checklists for developing public "hurricane awareness" programs, for evaluating hurricane preparedness plans, and for residents' actions in the face of a storm. Sketchy in its presentation of mitigation techniques, but clear and simple.

Owen, James H. and Glenn R. Wall (for U.S. Water Resources Council). 1981 (September). Floodplain Management Handbook. Washington, DC: U.S. Government Printing Office.

Provides very general guidance to local officials and concerned citizens for developing and implementing a floodplain management program. Outlines the full range of structural and non-structural measures to reduce flood losses and maintain the natural values of floodplains. Brief and comprehensive, but needs detail to make it more useful and interesting to local administrators. Deals with riverine and coastal flooding.

Rogers, Golden, and Halpern. 1981 (November). Hurricane Evacuation and Hazard Mitigation Study. Sanibel, FL: City of Sanibel.

This study addresses the hurricane-related development problems facing Sanibel Island and suggests ways that the local government can alleviate them. The first two chapters of the report examine the hurricane hazards facing Sanibel and Sanibel's ability to evacuate in a major storm; they culminate in an innovative program for staging evacuation from the island given different "time windows" in advance of a storm's projected landfall. The report then examines the community's building code and land use regulations to see if they adequately protect development from storm damages. It also outlines procedures for assessing damages, permitting repairs, and other response and recovery activities to be carried out after a hurricane strikes. The report defines a set of specific measures that Sanibel can adopt to improve its evacuation, damage reduction, and recovery programs, including each measure's advantages and disadvantages.

An excellent and thorough analysis of hazard conditions in the community and local government programs that deal with them. Even though the report is specific to Sanibel, it holds many insights for other communities.

U.S. Department of Housing and Urban Development--Federal Insurance Administration. 1977. Coastal Flood Hazards and the National Flood Insurance Program. Washington, DC: HUD.

This report describes the National Flood Insurance Program, its history, the impetus behind it, and its requirements. It presents the results of a field survey contrasting coastal residents' attitudes toward flooding with those in riverine communities. The survey found that people are more likely to rebuild in the same place in coastal communities, even though coastal flood damages are generally greater. The survey found that flood insurance rates generally do no affect the demand for coastal property. It also showed that local officials tend to be willing to adopt more stringent floodplain development regulations, but that communities have no impetus to go beyond the minimum standards of the NFIP.

U.S. Department of the Interior - Office of Water Research and Technology. 1979 (November). A Process for Community Flood Plain Management (Planning Manual OWRT-TT/79-9). Washington, DC: U.S. Government Printing Office.

Suggests a series of steps communities can take to identify flood hazards and to plan for avoiding them. The process is very general--geared toward riverine and coastal communities throughout the country--but it presents a well-balanced and objective approach to the wide variety of issues and available management techniques a community might face. The process touches on planning for post-disaster recovery, though its main thrust is pre-disaster mitigation. Includes brief, yet comprehensive, descriptions of available federal financial and technical assistance (a little dated) and sources of legal information. Appendix D--Notes on Obtaining Federal Assistance--offers several useful suggestions for local administrators.

U.S. Water Resources Council. 1972. Regulation of Flood Hazard Areas to Reduce Flood Losses (Volumes One and Two). Washington, DC: U.S. Water Resources Council.

This report presents a comprehensive analysis of the use of various development regulations at the state and local levels to reduce the risk of flood damages. It discusses in depth the basic regulations (zoning, subdivision, etc.) that comprise state and local floodplain management programs and the legal issues surrounding them. The report contains lists of how communities and states throughout the country are using land use and building regulations to reduce flood losses, including excerpts of selected state and local legislation.

Wilson, John, Daniel Trescott, DeeEll Fifield, and Vera McIntyre Hayes. 1980. Hurricane Hazard Mitigation at the Local Government Level. Tallahassee, FL: Florida Department of Community Affairs -- Bureau of Disaster Preparedness.

Good compilation of information which briefly describes the damaging forces of hurricanes and presents ways that building codes and other development management techniques can reduce hurricane losses. Concentrates on building code modifications as the key to hazard mitigation, relying on results from a statewide (Florida) survey of local building officials and modifications suggested in other reports. Provides little insight into the use of land use controls.

Geared toward conditions in Florida in discussing the state's damage potential, current hazard mitigation practices, and strategies available to local governments.

Land Use Management --

Cheatham, Leo R. 1979 (October). An Assessment of Some Economic Effects of FIA Land Use Requirements on Urban Coastal Zone Development. Mississippi State, MS: Mississippi State University - Water Resources Research Institute.

This study sought to determine if restrictions on construction, repairs, and land use in flood hazard areas had affected community growth and development, focusing on the construction industry, property values, and local property tax revenues. Using towns along Mississippi's Gulf Coast as the study population, the author found that floodplain land use regulations had not caused any significant decreases in residential and commercial construction in coastal floodplains or any decreases in property values and tax revenues.

Ralph M. Fields Associates, Inc. 1981 (September). State and Local Acquisition of Floodplains and Wetlands: A Handbook on the Use of Acquisition in Floodplain Management. Washington, DC: U.S. Water Resources Council. (Available from Natural Hazards Information Center -- University of Colorado.)

An excellent overview of the use of acquisition, different techniques of acquiring land, and funding sources. Describes common reservations about the use of acquisition and important factors a community should consider before pursuing acquisition. Outlines key elements and steps to follow in setting up an acquisition program. Describes different levels of property rights (fee simple and less-than-fee simple) and the advantages and disadvantages of each.

Presents ten case studies of communities throughout the nation which have implemented different floodplain acquisition programs. Each case study discusses the flooding problems facing each community and how each program was formulated to seize unique opportunities and meet unique needs. Unfortunately, the case studies deal mainly with riverfront, rather than oceanfront, communities, so the discussion fails to account for the strong development pressures and land constraints facing coastal communities. Otherwise, the book is clear, concise, and highly informative.

French, Steven P. and Raymond J. Burby. 1980 (January). Managing Flood Hazard Areas: The State of Practice. Chapel Hill, NC: UNC Center for Urban and Regional Studies.

This brief booklet reports the findings of a nationwide survey of local government and regional planning agency experiences with floodplain land use management. The survey covered such topics as the types of measures being used, program effectiveness, and obstacles to more effective management.

Pilkey, Orrin H. and William J. Neal. "Barrier Island Hazard Mapping" in Oceanus 23:4 (Winter 80/81). Woods Hole, MA: Woods Hole Oceanographic Institute.

Presents ways of identifying sections of barrier islands that pose hazards to development. Identifies key data sources for mapping island hazards, natural factors influencing island safety (erosion rate, topography, storm response, etc.), and man-made hazards influencing island safety (road construction, sand removal, finger canals, etc.). Points out the importance of island safety maps in government programs "concerning the wisdom of spending tax money to save threatened houses" and to give citizens "the opportunity to avoid building or buying a home in a dangerous location."

U.S. Army Corps of Engineers - Galveston District. 1975 (June). Guidelines for Identifying Coastal High Hazard Zones. Galveston, TX: U.S. Army Corps of Engineers.

Designed to provide uniform methods for identifying coastal high hazard zones (V-zones) in FIA Flood Insurance Studies (FIA did not adopt them). Outlines two methods for estimating wave heights and the inland extent of wave action during major storms. Identifies the three-foot breaking wave as the minimum size wave capable of causing major damage to a conventional wood frame structure. Mentions factors determining the inland extent of wave action (e.g. topography and vegetation). Intended "for application and use by technically oriented individuals with a general but limited knowledge of wave theory."

William Spangle and Associates, Inc. (for U.S. Geologic Survey). 1974 February). Application of Earth Science Information in Urban Land Use Planning: State-of-the-Art Review and Analysis. Washington, DC: National Techincal Technical Information Service (Report No. USGS-GD-74-038).

General assessment of the application of earth science information to land use planning. Includes an overview of the land use planning process and discussions of various natural resources and hazards. Lists sources of earth science information (may be a bit dated) plus different types of maps and other data.

Building Design and Construction --

American Insitute of Architects Research Corporation. 1981 (December). Design Guidelines for Flood Damage Reduction. (Prepared for FEMA, Report No. FEMA-15). Washington, DC: U.S. Government Printing Office.

Excellent overview of the general information needed and the tools available for design in flood-prone areas. Clearly and briefly presents the basic dynamics of riverine and coastal flooding and the evolution of flood protection policy in the United States. Chapter 4 -- Design Analysis for Flood Damage Reduction -- identifies two types of information to be used in floodplain management and design: regulatory information (e.g. National Flood Insurance Program maps and rates, local land use planning and construction guidelines, and other state and federal programs) and flood hazard data (e.g. data on streamflow and flood elevation, site characteristics, and the nature of existing development). Chapter 5 -- Design Techniques for Flood Damage Reduction -- outlines some basic site design and building design variations based on building use, site density, and new vs. existing construction. Includes a "Resource Index" with a glossary of key terms and a directory of state and regional offices of key agencies (FEMA, Corps of Engineers, USGS).

Not very technical; good general reading that everyone can understand.

Dames and Moore, Inc. 1981 (January). Design and Construction Manual for Residential Buildings in Coastal High Hazard Areas (Report No. FIA-7). Washington, DC: HUD - Office of Policy Development and Research, and FEMA - Federal Insurance Administration.

An excellent manual for the design and construction of homes to resist coastal flood, erosion, and wind hazards based on a comprehensive, nationwide evaluation of existing beach houses, common construction practices, and building codes. It briefly describes environmental conditions and construction practices in different coastal regions of the United States. It discusses various structural forces to be resisted, the adequacy of different materials, and recommended construction methods. It includes many well-illustrated design details and provides information on costs, and demonstrates the use of the design data tables contained in the appendices. The appendices provide clear and complete data on required piling sizes, embedment depths, bracing details, etc. While the manual concerns residential construction, most of the principles can be applied to non-residential buildings. A "must" for coastal builders and local officials.

Defense Civil Preparedness Agency. 1974 (February). Protecting Mobile Homes from High Winds (Report No. TR-75). Washington, DC: U.S. Government Printing Office.

A little dated, but an excellent description of a mobile home's vulnerability to high winds and recommended means of protection. Illustrates different types of tiedowns, anchors, and footings. Brief and easy to understand--designed for homeowners.

Defense Civil Preparedness Agency. 1975 (June). Wind-resistant Design Concepts for Residences (Report No. TR-83). Washington, DC: U.S. Government Printing Office.

Briefly outlines four risk-based design concepts, with useful examples of how each could be carried out in residential construction. Three of these four concepts have occupant safety as their main objective (designing in-home shelters); these are more appropriate for tornado-prone areas than for hurricane-prone areas (where there is adequate warning time to evacuate residents to other shelters). The fourth design concept--improved construction practices--has property damage reduction as its main objective. Following this concept, the booklet presents simple practices (bracing and joint connections) which protect against wind forces.

Illustrates different wind-induced pressures that act on a building and different types of structural failure. Includes a technical section on "How to Calculate Wind Forces and Design Wind-resistant Residences" aimed at homebuilders and architects.

Federal Emergency Management Agency--Flood Insurance and Hazard Mitigation. 1979 (June). Economic Feasibility of Floodproofing--Analysis of a Small Commercial Building (Report No. HUD-508-FIA). Washington, DC: U.S. Government Printing Office.

Points out the practicality of flood protection measures by showing how the cost of floodproofing a building can be outweighed by reduced flood insurance premiums and reduced average annual flood damages. Examines the costs and benefits of three floodproofing alternatives: elevating on fill to the base flood elevation, elevating on fill with watertight closures, and elevating on pilings. Even though the report deals with a specific case study (a 3,500 square foot retail building in Jersey Shore, Pennsylvania), the analytical methods used can be helpful in other communities for evaluating the economic feasibility of floodproofing commercial structures. Points out that the feasibility of different alternatives will depend on such local conditions as topography, soils, development density, construction budget, aesthetics, and the depth, duration, and frequency of flooding.

Straightforward and easy to understand.

Sheaffer and Roland, Inc. 1980 (July). Elevating to the Wave Crest Level -- A Benefit: Cost Analysis. Written for the Federal Emergency Management Agency (Report No. FIA-6). Washington, DC: U.S. Government Printing Office.

Finds that elevating a new house to the wave crest level associated with a 100-year storm surge reduces both average annual flood damages and flood insurance premiums to a point where each more than offsets the added costs of elevating to that height. Assesses three design alternatives with regard to cost and safety: rigid frame construction, semi-rigid frame with grade beam, and semi-rigid frame without grade beam. Uses conditions in Gulf Shores, Alabama (hit by Hurricane Frederic) as the basis for analysis, finding conditions there to be typical of the shoreline dynamics and construction practices along the South Atlantic and Gulf coasts.

Sheaffer and Roland, Inc. 1981. Coastal Construction Standards for Nags Head, North Carolina (Draft): A Report to the Mayor, Board of Commissioners, and Town Manager -- Town of Nags Head, North Carolina. Nags Head, NC: Town of Nags Head.

Clearly and concisely discusses the physical conditions found on the Outer Banks and current local, state, and federal regulations governing coastal construction (especially with regard to severe storm conditions). Recommends actions to amend the State Building Code and CAMA regulations and for the town to adopt minimum housing standards to supplement the state code. Briefly presents the evolution of current construction standards, what power local governments in North Carolina have to regulate construction, and recent developments in the National Flood Insurance Program's guidelines for construction in coastal high hazard areas (V-zones).

Excellent reading for local officials in North Carolina's oceanfront communities.

Texas Coastal and Marine Council. 1981 (June). Model Minimum Hurricane Resistant Building Standards for the Texas Gulf Coast. Austin, TX: Texas Coastal and Marine Council.

Explains natural hazards in Texas's coastal zone. Outlines a procedure for delineating four categories of hazard zones based on the different hurricane forces each is subject to:

Zone A -- scouring, battering (by waterbone debris), flooding, and high wind
Zone B -- battering, flooding, and high wind
Zone C -- flooding and high wind
Zone D -- high wind only.

Presents detailed building standards (designed to serve as an amendment to local building codes), which cover construction in the four zones. Standards include administrative procedures and design requirements (in the face of the forces listed above) for different zones and different types of construction (wood, masonry, etc.).

U.S. Army Corps of Engineers - Office of the Chief of Engineers. 1972 (June). Flood-proofing Regulations. Washington, DC: U.S. Government Printing Office.

Recommends minimum standards of design and construction for flood-proofing buildings. Deals only with the "static" forces associated with riverine flooding; gives no consideration to the "special problems of wave impact, corrosion and erosion associated with coastal flooding." Prepared in "a form that could be used to supplement existing building codes and regulations." Outlines administrative procedures and structural flood-proofing measures that a community may want to require of flood plain construction. Contains useful classifications of the damage-resistance of different flooring, wall, and ceiling materials and guidelines for the design and location of plumbing, heating, and ventilation systems.

Marginally useful for coastal communities, but an adequate reference for becoming familiar with some of the engineering concepts involved in flood-proofing.

U.S. Department of Housing and Urban Development - Flood Insurance Administration. 1976 (September). Elevated Residential Structures: Reducing Flood Damage Through Building Design. Washington, DC: U.S. Government Printing Office.

Provides a good overview and evaluation of common elevation techniques. Part 2 -- Designing Elevated Foundations -- presents design and construction guidelines for wood post, wood pile, and reinforced concrete/masonry construction. Ample illustrations accompany the concepts described (regarding site conditions, utilities placement, insulation, breakway walls, bracing techniques, framing, and connections). Part 3 -- A Brief Survey of Design Improvements -- illustrates a few sample designs for various housing types, various heights above grade, and various regions of the country. Part 4 -- Cost Analysis of Elevating Foundations -- presents an approach (and sample worksheets) for estimating and comparing costs of different modes of construction.

Evacuation --

N.C. Division of Civil Preparedness (now Division of Emergency Management). 1977 (March). Carolina County Civil Preparedness Hurricane Evacuation Plan. Raleigh, NC: N.C. Department of Crime Control and Public Safety.

A brief and simple model for evacuation planning in coastal North Carolina. Designed for use by local government administrators. Contains a good "Increased Readiness Action Checklist" that lists responsibilities of different local officials during different stages of a hurricane threat. Local evacuation plans in North Carolina have followed this prototype.

Stone, John R. 1982 (forthcoming). Hurricane Emergency Planning: Estimating Evacuation Times for Non-metropolitan Coastal Communities. Raleigh, NC: UNC Sea Grant College Program.

This brief and easy-to-follow report presents simplified, non-computerized methods of estimating evacuation times in coastal communities that have few evacuation zones and an uncomplicated set of evacuation routes. It describes the different components of evacuation time and a way of analyzing them that could be used in local evacuation planning. The study applies this methodology to two communities in coastal North Carolina (Holden Beach and Goose Creek Island) to illustrate different analytical techniques and considerations that go into evacuation planning.

Southwest Florida Regional Planning Council. 1981 (November). Southwest Florida Regional Hurricane Evacuation Plan. Fort Myers, FL: Southwest Florida Regional Planning Council.

This comprehensive, multi-county evacuation plan is based on computer simulations of wind speeds and storm surge levels (using NOAA's SLOSH model) for hurricanes of different intensities that can be expected to strike the region. It uses recent advances in storm flooding predictions to more accurately identify the time needed for evacuation. The plan identifies different evacuation zones based on the different flooding levels that can be expected for storms of different strengths. It estimates the population in each zone that would need to evacuate, inventories temporary shelters and their capacities, identifies evacuation routes, and estimates needed evacuation times.

The plan is thorough and a good model for similar efforts elsewhere. Whether or not evacuation planners have such an advanced set of data on expected flood levels, they can follow some of the procedures and considerations used in southwest Florida.

Tampa Bay Regional Planning Council and U.S. Army Corps of Engineers - Jacksonville District. 1981 (June). Tampa Bay Region, Florida, Hurricane Evacuation Plan. St. Petersburg, FL: Tampa Bay Regional Planning Council.

This plan uses essentially the same procedures as the Southwest Florida RPC's plan, incorporating advanced data an expected storm surge levels and their timing to estimate needed evacuation times. Like the Southwest Florida plan, it applies to a heavily populated, multi-county region (around Tampa and St. Petersburg) which faces a strong threat of hurricane damages.

Disaster Assistance

Federal Emergency Management Agency. 1981 (September). Flood Hazard Mitigation: Handbook of Common Procedures--Interagency Regional Hazard Mitigation Teams. Washington, DC: FEMA (Report No. FEMA-14).

This handbook describes the procedures for Interagency Regional Hazard Mitigation Teams to follow in their survey and planning efforts both before and after a flooding disaster (including a hurricane) occurs. The procedures and information in the handbook are designed to help a team produce a practical, technicaly sound, and implementable Hazard Mitigation Report. Insofar as local officials will participate on these teams, the guide is a useful document for local governments to have.

Federal Emergency Management Agency. 1981 (August). Federal Disaster Assistance Program: Documenting Disaster Damage Pursuant to Public Law 93-288. Washington, DC: Federal Emergency Management Agency (Report No. DR&R-7).

This short companion to the Handbook for Applicants (DR&R-1) will help applicants for federal disaster assistance avoid accounting problems and funding delays. It clearly and briefly presents the key documents involved (Damage Survey Report, Project Application, Final Inspection Report, Project Listing, and Request for Advance or Reimbursement) and uses hypothetical examples to show how the forms should be filled out. It also presents simple "Suggested Records Systems" which can help local governments organize their records to file claims and meet audit requirements with a minimum of time and effort.

Federal Emergency Management Agency. 1981 (July). Federal Disaster Assistance Program: Eligibility Handbook Pursuant to Public Law 93-288. Washington, DC: FEMA (Report No. DR&R-2).

This handbook, designed primarily for federal and state inspectors, defines FEMA's guidelines for determining whether applicants are eligible to receive public assistance or other work authorized by the Disaster Relief Act of 1974. It also outlines policies and procedures for preparing Damage Survey Reports and inspecting completed work. It includes samples of the forms used in administering FEMA's public assistance program.

Federal Emergency Management Agency. 1981 (March). Federal Disaster Assistance Program: Handbook for Applicants Pursuant to Public Law 93-288. Washington, DC: Federal Emergency Management Agency (Report No. DR&R-1).

Describes procedures for local governments to follow in requesting, obtaining, and administering federal (FEMA) grants for public assistance after a presidential disaster declaration. Local government officials will find this volume useful; it brings the guidelines established in various FEMA regulations under one cover and contains sample copies of the forms one must use to apply for federal disaster assistance.

An excellent reference that all local administrators should have.

Federal Emergency Management Agency. 1981 (March). Federal Disaster Assistance Program: Insurance Handbook for Public Assistance Pursuant to Public Law 93-288. Washington, DC: FEMA (Report No. DR&R-3).

Public agencies and certain non-profit organizations are required to maintain general hazard insurance or flood insurance on certain projects as a condition to receiving disaster assistance from FEMA. This handbook defines FEMA's policies and procedures for administering its insurance requirements; it covers only public sector projects, not those classified as "individual assistance". It includes samples of the forms to be used by FEMA and the applicant.

Federal Emergency Management Agency. 1981 (January). Federal Disaster Assistance Program: Community Disaster Loan Handbook Pursuant to Public Law 93-288. Washington, DC: FEMA (Report No. DR&R-5).

The Disaster Relief Act authorizes FEMA to make "Community Disaster Loans" to local governments in the aftermath of disasters. This handbook describes this loan program, its eligibility requirements, and its administrative procedures. It includes samples of the forms a loan applicant must submit to FEMA.

Federal Emergency Management Agency. 1980 (June). Digest of Federal Disaster Assistance Programs. Washington, DC: FEMA (Report No. DR&R-9).

This digest catalogs the full range of federal disaster assistance programs that are available to private individuals and public agencies, running the gamut from crop insurance to the donation of federal surplus property. The description of each program includes the purpose and nature of assistance available, the responsible federal agency, and the program's eligibility requirements. This is an excellent source of information on disaster assistance programs. However, since federal programs can change easily (by having appropriations cut or being legislated out of existence), the information on some programs may be obsolete.

Federal Emergency Management Agency. 1980 (February). Program Guide. Washington, DC: Federal Emergency Management Agency (Report No. MP-91).

Briefly outlines the procedure for requesting a Presidential declaration of "major disaster" or "emergency", describes federal actions after the declaration, and lists categories of federal assistance available to individuals, local and state governments, and private non-profit institutions. Also outlines categories of federal assistance available without a Presidential declaration.

N.C. Division of Civil Preparedness (now Emergency Management). 1976. North Carolina Disaster Relief and Assistance Plan. Raleigh, NC: N.C. Department of Military and Veterans Affairs.

This plan "establishes the concepts under which State and local governments will operate in response to disasters by:

a. Defining the responsibilities and authorities of local governments and state departments and agencies;
b. Defining the emergency roles and missions of local governments and state departments ans agencies; and
c. Providing direction for the execution of measures to provide relief and assistance."

It is the basic document setting forth the State's disaster response procedures. The plan has been continuously updated since it was first adopted in 1976.

N.C. Division of Emergency Management. 1981. Carolina County Disaster Relief and Assistance Plan. Raleigh, NC: N.C. Department of Crime Control and Public Safety.

This plan was designed as a prototype for local governments to use in developing relief and assistance procedures for disasters. The plan outlines the procedures, roles, and responsibilities of different local, state, and federal agents in communications/warnings, damage assessment, and the operation of shelters and disaster assistance centers. Includes model ordinances and interagency agreements for local governments to adopt to facilitate disaster relief operations. Includes several annexes dealing with particular disasters (from flash floods to plane crashes). General in scope; can apply to any or all natural disasters a community faces.

APPENDIX C:

SAMPLE CONSTRUCTION STANDARDS

Following are two examples of local ordinances which deal with the location and design of buildings in storm hazard areas.

First is a set of amendments adopted by the Town of Scituate, Massachusetts, establishing standards for the reconstruction of buildings destroyed by wave action. These were adopted in response to the massive damage Scituate suffered in the Great Blizzard and Coastal Storm of February 1978, a northeaster which destroyed over 90 homes in the town and damaged over 1,000 others.

Second is the supplemental building code adopted by the Town of Gulf Shores, Alabama, establishing standards for the design and construction of buildings in coastal high hazard areas. The code was adopted in response to the extensive damage Gulf Shores suffered from Hurricane Frederic in September 1979.

These standards are not presented as models for North Carolina's coastal communities to duplicate blindly or verbatim. They are presented as approaches that coastal communities could consider in developing their own storm hazard reduction policies. Each set of standards does a good job of relating building design criteria to the hazards present in certain sections of the community (considering expected flood elevations, wave heights, and high winds).

Town of Scituate CONSERVATION COMMISSION

SCITUATE MASSACHUSETTS

June 7, 1979

Amendments made by Building Commissioner, Conservation Commission, Planning Board/CZM Representative as Preliminary Storm-Damage Mitigation Effort

Guidelines for reconstruction of residences destroyed by coastal wave action:

1. For any residence with a septic system, written certification of inspection of the existing system from the Scituate Board of Health, Health Agent, or a registered professional engineer or a design for a system approved by the Board of Health shall be submitted with the Notice of Intent.

2. First floor sill elevation of structure shall be at or above 17 ft MSL (Mean Sea Level) or at least 5 ft above ground level, whichever is higher.

3. Structures located in coastal areas as designated on a map on file with the Building Inspector and Conservation Commission shall have plans drawn by a registered professional engineer or architect and shall be designed to be anchored to piles and meet all other requirements of the Massachusetts State Building Code, section 748.1.

4. Pile foundations shall conform to sections 735 through 744 of the State Building Code. The bottom elevation of all piles shall be below -5.0 ft MSL.

5. When the foundation consists of timber piles and beams, the headers or joists shall be secured to the beams with anchors at intervals not exceeding four feet. The anchors shall not be less than 1" x 1/8" steel strap, nailed to each member with three 16d nails. All anchors and nails shall be hot-dip galvanized. Gusset plates and bolts securing the beams to the pilings shall be hot-dip galvanized or the equivalent.

6. Structures located in coastal areas other than those designated on the map on file with the Building Inspector and the Conservation Commission may be constructed on piles or a poured concrete foundation wall. Pile foundations shall conform to sections 4 and 5 above. Poured concrete walls shall conform to section 7 below.

7. Where poured concrete foundation walls are permitted, the walls shall conform to the following:

   a. The footings of the wall shall be at elevation 5 ft MSL or at least 4 ft below finished grade, whichever is lower.

   b. The foundation wall of the structure shall be not less than 12" thick and reinforced to resist lateral loading from wave action. The reinforcement shall consist of not less than No. 3 bars located 6" on center vertically and horizontally or the equivalent.

c. The structure shall be securely anchored to the foundation walls by $\frac{1}{2}$" diameter galvanized bolts, spaced not over 4 ft on center and embedded not less than 7" in the masonry.

8. All utilities except service lines shall be located above elevation 17.0 MSL.

9. When the structure is raised on piles above grade, all soil pipe below elevation 17 ft MSL shall be of cast iron and securely attached to the shoreward side of a pile.

10. Fuel tanks shall be buried or securely anchored in place or shall be located within the concrete foundation walls. Vent and fill pipe openings shall be located at or above elevation 12.0 MSL and approved by the Fire Department.

11. A survey of the site prepared by a registered land surveyor with 1 ft contours and all existing or proposed structures shown shall be submitted with the Notice of Intent.

12. Architectural or structural plans drawn to scale of the foundation of the structure shall be submitted with the Notice of Intent.

13. When the structure is raised on pilings, there shall be no obstruction between the pilings that would prohibit the free passage of wave or flood waters. However, after prior approval by the Conservation Commission, breakaway skirting may be used where it meets these objectives.

14. No liquid or gas burning equipment shall be located below elevation 17 ft MSL.

15. When a project has been completed in accordance with plans stamped by a Registered Professional Engineer, Architect, Land-Surveyor, or Landscape Architect, a written statement by the aforesaid professional people, certifying compliance with the plans shall accompany the said request for a Certificate of Compliance.

16. When a foundation has been completed, certification shall be furnished to the Commission by a registered land surveyor or professional engineer indicating that the elevation of the top of the foundation is in accordance with the plans as approved by the Conservation Commission in the Orders of Conditions.

* * * * * * * * * * * * * * * *

After evaluating potential adverse effects of the reconstruction, the Conservation Commission may impose additional conditions if necessary to protect the interests of GL Ch. 131, s. 40.

SUPPLEMENTAL BUILDING CODES FOR COASTAL CONSTRUCTION IN HIGH HAZARD AREAS

Town of Gulf Shores
Adopted Oct. 26, 1981
Ordinance No. 222

ORDINANCE NO. 222

AN ORDINANCE DESIGNED TO SET MINIMUM REQUIREMENTS AND GIVE GUIDANCE TO DESIGNERS, BUILDERS, AND HOME OWNERS WHO WISH TO BUILD STRUCTURES THAT WILL SURVIVE HURRICANE FORCE WINDS AND WATER SURGE IN GULF SHORES COASTAL HIGH HAZARD AREAS.

BE IT ORDAINED BY THE TOWN COUNCIL OF THE TOWN OF GULF SHORES, ALABAMA, AS FOLLOWS:

Section 1. SCOPE

1. The requirements stated herein are supplements to the Southern Standard Building Code, latest edition, a code that was adopted by the Town of Gulf Shores in compliance with the Federal Flood Control Act of 1968.

2. The areas governed by this code supplement shall be the Town of Gulf Shores coastal high hazard areas; more particularly, those areas designed as V-zones by the Flood Hazard Boundary Maps issued by the Federal Insurance Administration.

3. The provisions of this code supplement are primarily addressed to construction of wood frame, raised on piling for one or two family structures. Other structures are covered, but not to the same degree or detail.

Section 2. DEFINITIONS

1. **Coastal High Hazard Areas**

The portion of a coastal flood plain having special flood hazards, especially those areas subject to high velocity waters, including hurricane wave wash and winds associated with a 100-year storm event (i.e., FIA V-ZONES).

2. **Design Wind Speed**

That velocity associated with the 100-year recurrence of the fastest wind mile. For these regulations, the wind velocity map published in the Southern Standard Building Code, latest edition, shall govern.

3. **Fastest Wind Mile**

The average speed of one mile of air passing an anemometer. Example: A fastest mile windspeed of 120 MPH means that a "mile" of wind passed the anemometer during a 30-second period.

4. **FIA**

Flood Insurance Administration

5. **Flood Hazard Boundary Map (FHBM)**

Maps issued by the Federal Insurance Administration illustrating the degree of flood hazard for all areas of a community.

6. **Habitable Floor**

Any floor used for living, which included working, sleeping, eating, cooking, recreation, or combination thereof.

7. **Mean Sea Level (MSL)**

For these regulations, mean sea level shall be taken as the National Geodetic Vertical Datum (NGVD).

8. Substantial Improvements

Any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds 50% of the market value of the structure before the improvement is started.

Section 3. APPLICATION FOR BUILDING PERMIT

1. Procedure for Submission

a. Submit two (2) copies of construction drawings and specifications; elevation showing ground elevation above MSL and temporary bench mark signed by a land surveyor or engineer registered to practice in the State of Alabama, bearing his seal and signature.

b. For two-family structures, the requirements of The Registration Act, No. 79-676, State of Alabama, passed July 30, 1979, must be met when applicable.

2. Plans Required for Approval

a. **Plot Plan.** Submit two (2) copies attached to the construction drawings, showing the dimension and bearings of the property lines and dimensioned location of the proposed structure.

b. **Foundation Plan.** This plan shall show construction details of the structures support members.

c. **Floor Plan**

d. **Elevations**

e. **Wall Sections and Construction Details.** Drawings indicating in detail the connectors and/or methods used to provide continuous interconnection from the foundation support to the roof framing (Figures VII and VIII); showing 2 x 8 X-bracing on piles (Figure III); and 3/8" or 1/2" galvanized bolts with 2" washers on both ends of bolts. Show 1" x 4" let-in bracing (Figure V), or diagonal sheathing (Figure IX).

f. **Roof Framing Plan.** Plans shall include a view of the roof structure, indicating the size, spacing, and bracing of all roof members. Where prefabricated trusses are used, a manufacturer's drawing of the truss shall be attached to the plans and shall bear the seal and signature of the engineer approving them.

g. **Electrical, Plumbing, and Mechanical Details.**

h. **Specifications.**

Section 4. DESIGN CRITERIA

Design criteria stated herein are supplements to the existing Southern Standard Building Code and supersede where overlapping occurs.

1. Wind Loads. All components of the framing envelope of a structure shall be designed to withstand the wind loads stipulated in the Southern Standard Building Code with a 2:1 factor of safety. The overturning moment and uplift forces calculated from wind pressure shall not exceed 50% of the sturcture's resistance.

2. Storm Waves. The forces of a wave may be realized when one considers that a cubic yard of water weighs over three-fourths of a ton. Therefore, when a breaking wave moves shoreward at speeds of up to 50 MPH, the resultant forces can be one of the most destructive elements of a hurricane. Waves also cause damage by impacting structures with floating debris and by undermining support members causing sturctures to collapse and/or lose substantial resistance to overturning.

The requirements of this code supplement are intended to significantly increase the likelihood of structure survival during 100 year storm events, without placing the construction cost of ordinary cottages or homes beyond the point of economic feasibility.

Section 5. RESIDENTIAL STRUCTURES, ONE- OR TWO-FAMILY - WOOD FRAME

1. Fundamental Rule. All structural elements must be fastened together and anchored to the ground in such a manner as to resist design forces, regardless of which direction these forces may come from.

2. Foundations. Only timber supports are addressed in this section. Other materials and methods may be used if the requirements of Section 6 are met.

a. The lowest horizontal member supporting the lowest floor must be elevated above the 100 year base flood elevation plus the wave height dictated by the National Flood Insurance Administration.

b. Piles shall be pressure treated to prevent decay and resist attack from insects.

c. Minimum tip of round piling shall be 8" and square piling shall be 8".

d. Piling must be designed to provide dead load support as well as the anticipated live loads associated with the 100 year flood event.

e. Piling shall have a minimum embedment of 5' below sea level or a minimum of 10' 0", whichever is the greater. The only exception to this would be where structure loads or characteristics require greater embedment to meet the provisions of Section 4.

f. Piles shall be bolted to all structural support members with not less than two 5/8" diameter galvanized bolts with minimum 2" diameter washers.

g. No two girders shall join on the same piling unless it is on the outside piling.

h. Alternate pile bracing as shown in Figure III A.

3. Floor Framing.

a. Maximum spacing of all framing shall be 16" o.c.

b. All floor joists shall be fastened into girders or beams with galvanized hurricane clips or straps at each joist and nailed with four 8d galvanized nails.

c. Boxed floor joists may be allowed (see Figure IV), or cantilever floor systems if it does not go beyond the girder or beam more than 12". Longer cantilever could be permitted at discretion of Building Official (see Figure II).

d. Subflooring shall be 3/4" tongue and groove, 6" boards, or 3/4" plywood nailed with 2-8d nails to each joist or nailed 6" apart on plywood of minimum of 3/4" thickness, using a combination of 1/2" plywood and particle board or masonite.

e. Where boxed floor joists are used, all joists shall rest on 2" x 4" ledger. Use 3-16d galvanized nails at each joist. If joists larger than 8" are utilized, undercut bearing end to fit ledger (Figure IV).

4. **Wall Construction.**

a. Maximum spacing of all wall studs shall be 16" o.c.

b. Each stud shall be fastened to floor and roof framing with 1" x 24" - 18 gauge galvanized hurricane straps with 4-8d galvanized nails at each end (see Figure X), except where siding ties floor joists together with studs.

c. Corner bracing shall be as in Figures V and VI. All corners shall be braced and where partition joins outside walls.

d. Horizontal straps shall be installed at top and bottom plates on all exterior corners. Minimum strap size shall be 1" x 24" - 18 gauge. Straps shall be fastened with 8d galvanized nails at each end (see Figure VII).

e. Windows and exterior doors must have manufacturer's certification that the unit will withstand the wind loads stipulated in the Southern Standard Building Code.

5. **Roof Framing**

a. Each truss or rafter shall be connected to the nearest stud below with 1" x 24" - 18 gauge galvanized metal straps, or approved hurricane straps.

b. Roof decking shall be 3/4" tongue and groove 6" boards nailed with 2-8d galvanized nails into each rafter and/or truss or 1/2" plywood (4-ply) nailed no more than 6" o.c. Plyclips shall be used with plywood.

c. All asphalt or fiberglass asphalt shingles shall be of the "Seal-Tab" type and shall have a maximum exposure of 4".

6. **Plumbing**

a. Septic tanks and absorption fields shall be installed according to Baldwin County Health Department regulations.

b. Water heater shall not be placed below finished floor elevation.

c. Supply and drain piping shall be securely fastened to floor members, and all vertical runs to ground level shall be strapped to support piles.

7. **Mechanical/Electrical.** No electrical appliance shall be installed below finished floor level. Air conditioner compressors may rest on cantilever floor joists. Fastening shall be provided to accomplish the provisions of Section 4, 4.01.

Section 6. BUILDINGS OTHER THAN ONE- OR TWO-FAMILY WOOD FRAME STRUCTURES

1. This section is intended to cover commercial buildings, condominiums, apartments, etc. Also included are one- and two-family units utilizing non-wood structural components.

2. All structures in this category shall be designed by an architect or engineer to meet the requirements of the Southern Standard Building Code for coastal high hazard areas. He/She shall affix his/her official seal and signature to all drawings, specifications, and accompanying data. See The Registration Act No. 79-676, State of Alabama, passed July 30, 1979.

Section 7. CHANGE TO EXISTING STRUCTURES

Non-substantial improvements to existing structures may be permitted if, in the opinion of the Gulf Shores Building Official, the requirements of this code supplement are met.

Section 8. INSPECTIONS

Inspections are made at various intervals of construction, and no work shall be done beyond these stages. Two days' notice is required for the inspection.

1. **First Inspection.** If on pilings, the first inspection shall be when pilings are set in place, all floor framing, braces, and sub-floor installed. If a building is built on slab or on piers, the first inspection shall be made after trenches are excavated and forms erected, all rod, wire mesh, vapor barrier, and termite treatment made and bond presented.

2. **Second Inspection.** When all roof, wall framing, braces, outside sheathing, roof sheathing, and all plumbing and electrical rough-in are complete.

3. **Final Inspection.** The final inspection is made after the building is complete and ready for occupancy. The building shall not be occupied until a Certificate of Occupancy is issued. The Building Inspector will issue this on the final inspection, if the structure passes all code requirements.

Section 9. EXHIBITS

Exhibits A (Piling Spacing), B (Detail Thru-Joists), C (Piling Cross Bracing), D (Typical Section - Alternate Pile Bracing), E (Floor Joist Details), F (Detail Let-In Corner Bracing), G (Detail Plywood Corner Bracing), H (Wall to Floor Framing), I (Wall to Roof Framing), J and K, are attached hereto and are specifically made a part of this ordinance.

ADOPTED, this the 26th day of October, 1981.

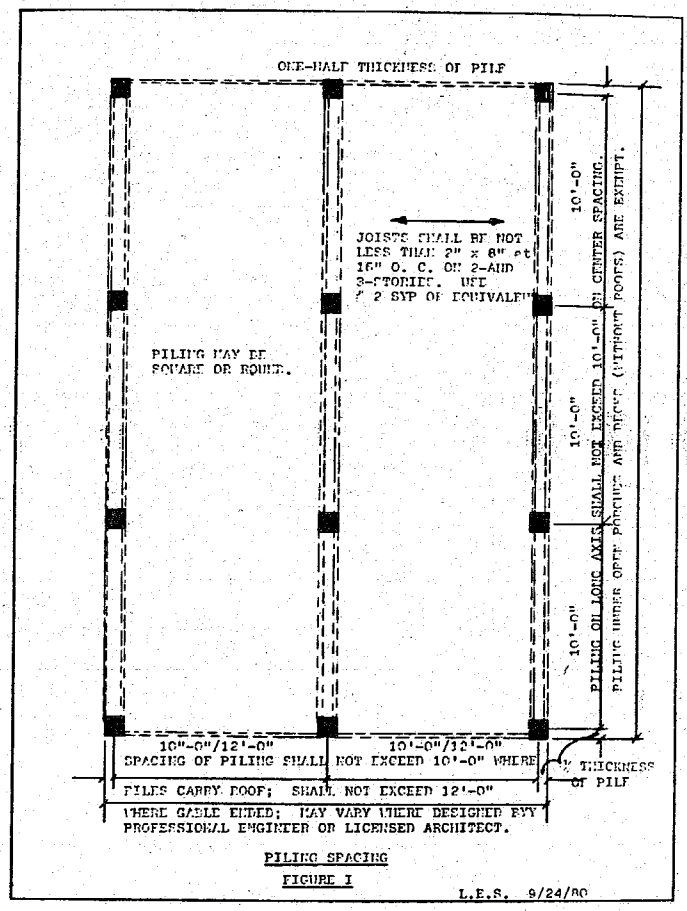
Thomas B. Norton
MAYOR

ATTEST:

Don E. Howell
Town Clerk/Administrator

I, Don E. Howell, Town Clerk/Administrator of the Town of Gulf Shores, Alabama, do hereby certify that the foregoing is a true and correct copy of Ordinance No. 222, which was duly and legally adopted at a regular meeting of the Town Council on October 26, 1981. Posted, via, Municipal Building, Public Library, Police Station, and United States Post Office, all located in Gulf Shores, Alabama.

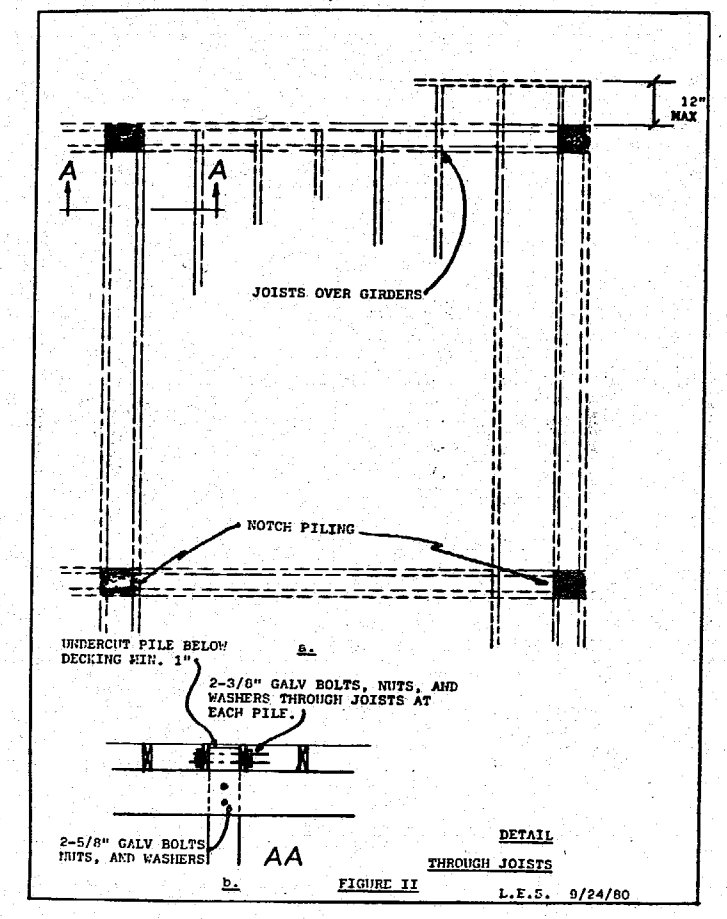
Don E. Howell
Town Clerk/Administrator



PILING SPACING

FIGURE I

L.E.S. 9/24/80

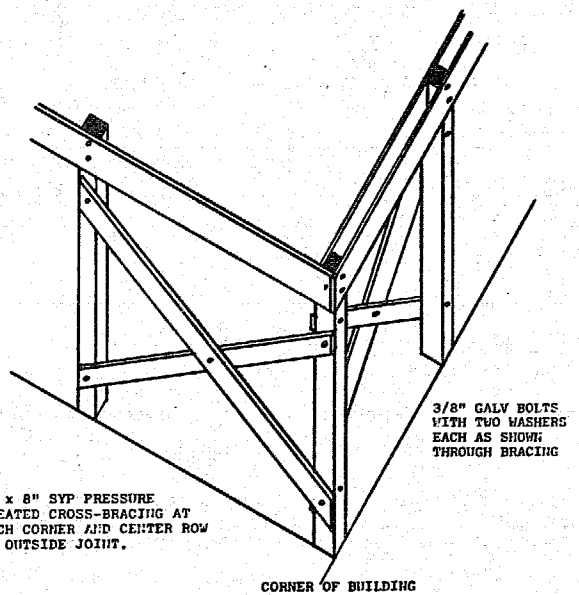


DETAIL

THROUGH JOISTS

FIGURE II

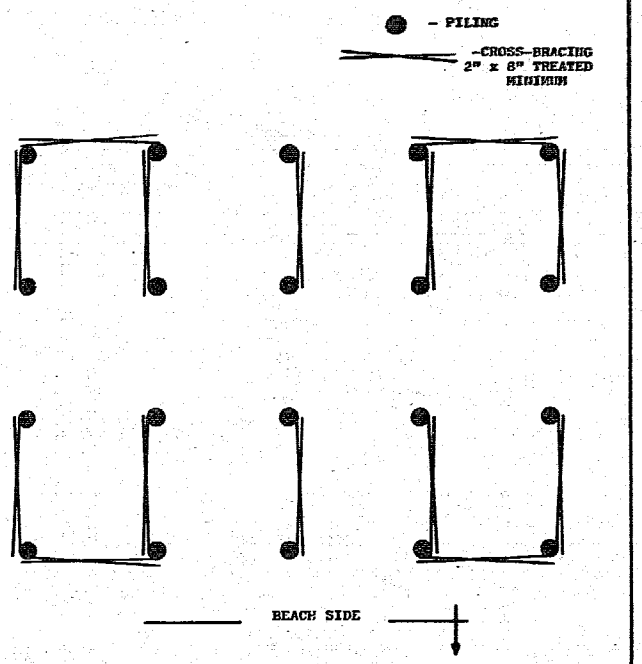
L.E.S. 9/24/80



PILING CROSS-BRACING

FIGURE III

L.E.S. 9/24/80

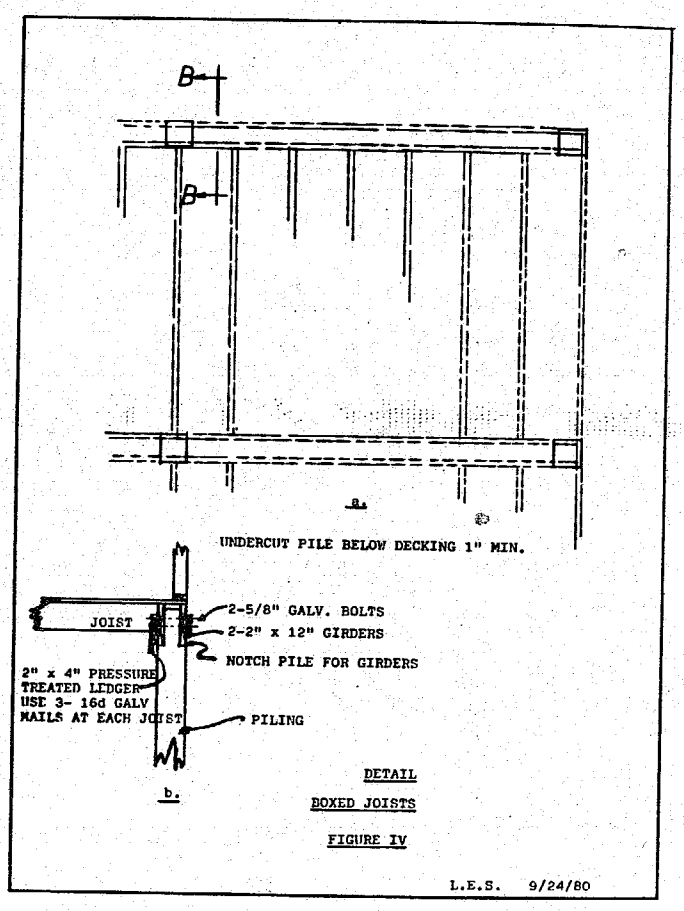


PLAN VIEW

PILING CROSS-BRACING

FIGURE III-A

L.E.S. 9/24/80

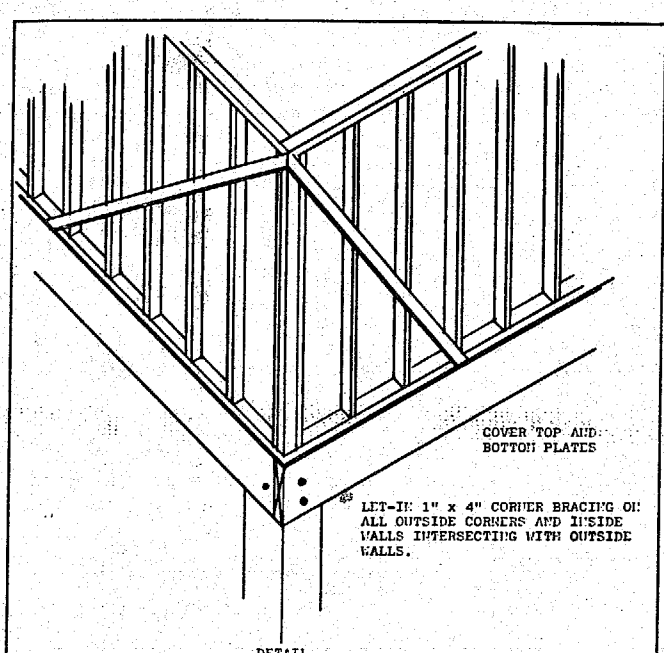


DETAIL

BOXED JOISTS

FIGURE IV

L.E.S. 9/24/80

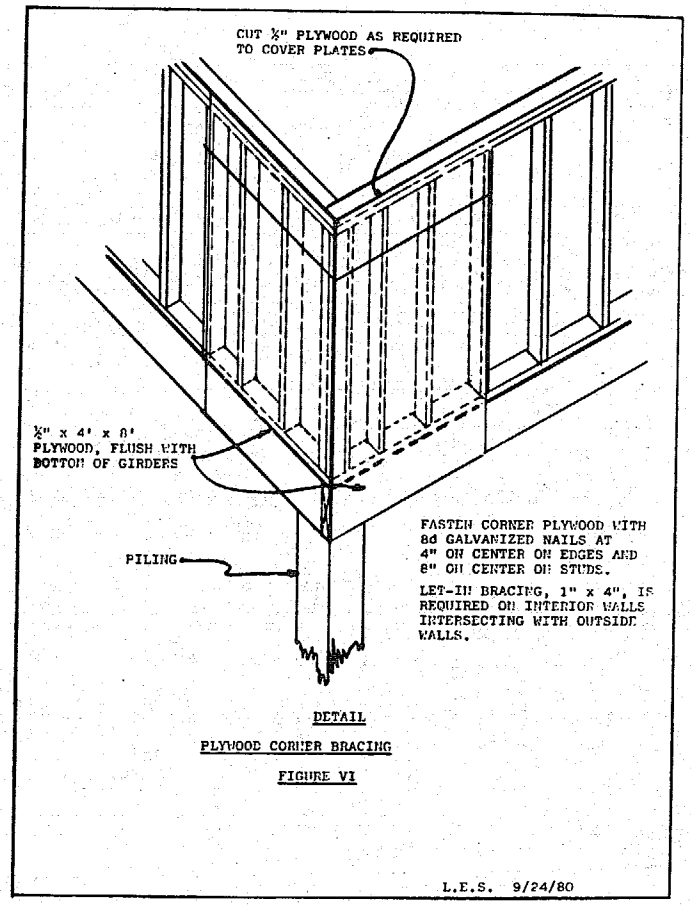


DETAIL

LET-IN CORNER BRACING

FIGURE V

L.E.S. 9/24/80

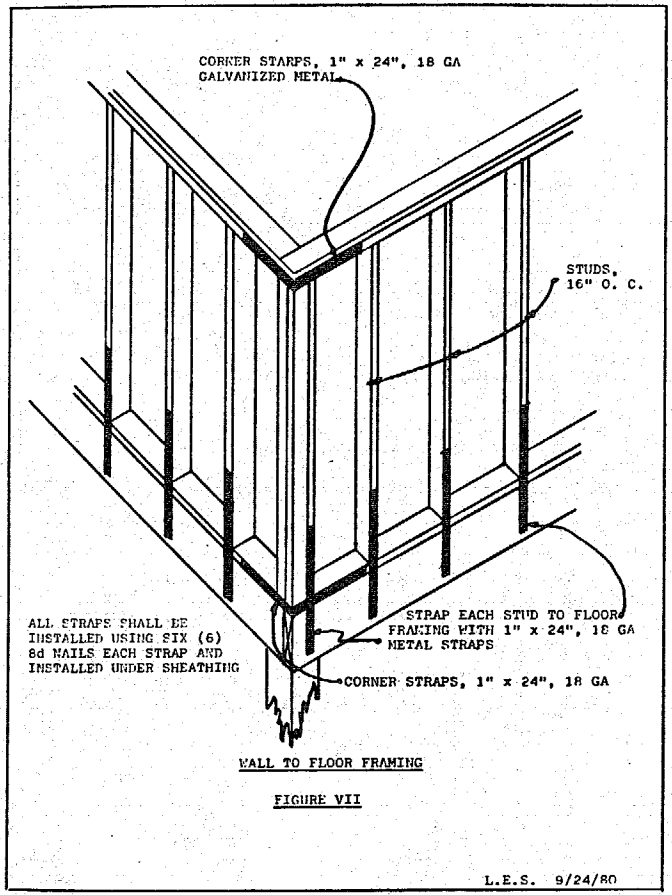


DETAIL

PLYWOOD CORNER BRACING

FIGURE VI

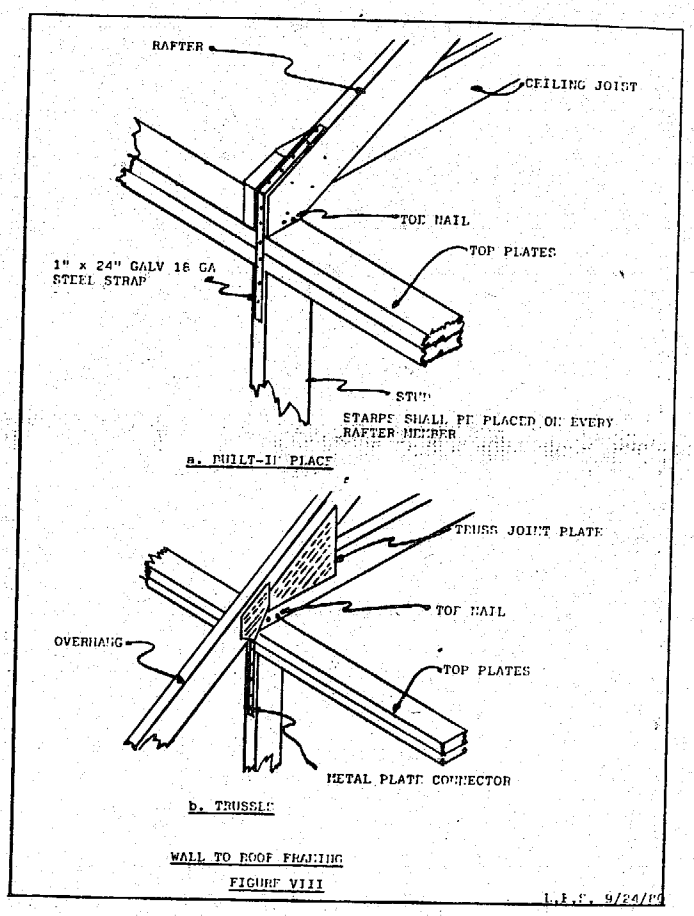
L.E.S. 9/24/80



WALL TO FLOOR FRAMING

FIGURE VII

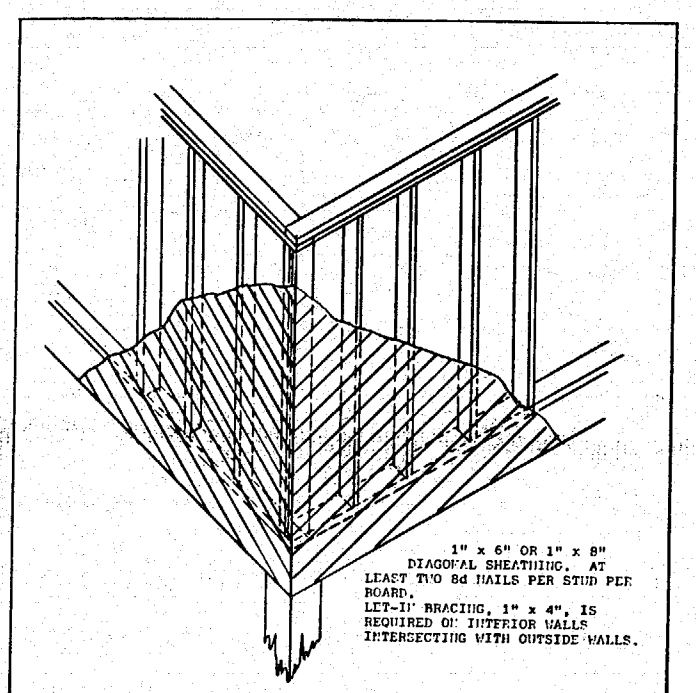
L.E.S. 9/24/80



WALL TO ROOF FRAMING

FIGURE VIII

L.E.S. 9/24/80

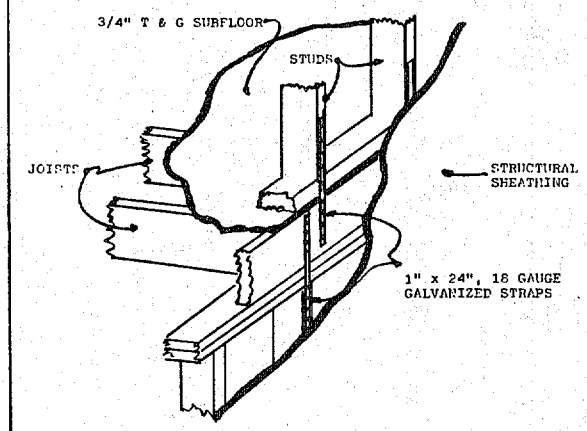


1" x 6" OR 1" x 8" DIAGONAL SHEATHING. AT LEAST TWO 8d NAILS PER STUD PER BOARD.
LET-IN BRACING, 1" x 4", IS REQUIRED ON INTERIOR WALLS INTERSECTING WITH OUTSIDE WALLS.

DIAGONAL SHEATHING

FIGURE IX

L. E. S. 9/24/80



1ST TO 2ND FLOOR INTERCONNECTIONS

FIGURE X

APPENDIX D:

DIRECTORY OF STATE AND FEDERAL AGENCIES

N.C. OFFICE OF COASTAL MANAGEMENT

State Office:
Office of Coastal Management
Department of Natural Resources
and Community Development
P.O. Box 27687
Raleigh, NC 27611 (919) 733-2293

Field Offices:
Office of Coastal Management
DNRCD
108 South Water Street
Elizabeth City, NC 27909 (919) 338-0206

Office of Coastal Management
DNRCD
P.O. Box 769
Morehead City, NC 28557 (919) 733-2160

Office of Coastal Management
DNRCD
1502 North Market Street
P.O. Box 1507
Washington, NC 27889 (919) 946-6481

Office of Coastal Management
DNRCD
7225 Wrightsville Avenue
Wilmington, NC 28401 (919) 256-4161

N. C. DIVISION OF EMERGENCY MANAGEMENT

State Office:
Division of Emergency Management
Department of Crime Control and
Public Safety
116 West Jones Street
Raleigh, NC 27611 (919) 733-3867

Area Offices:
- For planning regions Q and R--
Area Emergency Management Coordinator
N. C. Division of Emergency Management
607 Bank Street
Washington, NC 27889 (919) 946-2773

- For planning regions M, N, O, and P--
  Area Emergency Management Coordinator
  N. C. Division of Emergency Management
  Route 3, Box 8F
  Wallace, NC 28466 (919) 285-2871

N. C. DIVISION OF COMMUNITY ASSISTANCE (National Flood Insurance Program Information)

Flood Insurance Coordinator
Division of Community Assistance
Department of Natural Resources
and Community Development
P.O. Box 27687
Raleigh, NC 27611 (919) 733-2850

FEDERAL EMERGENCY MANAGEMENT AGENCY

National Office: Federal Emergency Management Agency
500 C Street, S.W.
Washington, DC 20472

Public Information	(202) 287-0300
Publications Department	(202) 287-0689

Regional Office: Federal Emergency Management Agency
Region IV
1375 Peachtree Street, N.E.
Atlanta, GA 30309

Public Information	(404) 881-2000
Disaster Assistance Prog.	(404) 881-3641
Flood Insurance Program	(404) 881-2391